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EDISON'S TELEPHONIC AND ACOUSTIC INVENTIONS.

By GEORGE B. PRESCOTT.

SOME of the discoveries and inventions of Mr. Edison, that were made during his researches which culminated in the invention of the carbon-telephone, have already been published. We now propose to present a more complete description of the important forms of telephone upon which he then experimented, and to describe his more recent acoustic inventions.

The carbon-telephone is only one of many contrivances for reproducing articulate speech at a distance through the aid of electricity, but, owing to its clear and truthful articulation, its simplicity of construction, and the far greater volume of sound which it creates, is probably destined to be the most extensively used. Other instruments of Mr. Edison's invention, however, are not far behind it, and may by improvement be made equally effective.

As a rule, Mr. Edison has succeeded better with those telephones which produce a variation in the resistance of the circuit than with those which depend for their action upon a variation of the electromotive force or static charge. An instrument very similar to the carbon-transmitting telephone is shown in Fig. 1, the essential difference being that the carbon is replaced by bibulous paper moistened with water. This semi-conductor, like the carbon, changes its resistance under the influence of varying pressure. The paper is kept moist by capillary action, a strip being used, one end of which dips into a reservoir of water.

In Fig. 2 is shown a form of the carbon-transmitting telephone, requiring no adjustment whatever. It operates well, notwithstanding the simplicity of its construction. A plate of metal rests on the bottom of a hollow vessel. On this is placed a block of prepared carbon, upon which a second and light plate is laid.

The weight of the upper plate affords an initial pressure which is varied by speaking into the mouth of the vessel.

The carbon-block may be replaced by a disk of cloth, the pores of which have been filled with pulverized black-lead. By this treatment the cloth becomes slightly conductive. The instrument thus modified is shown in Fig. 3.

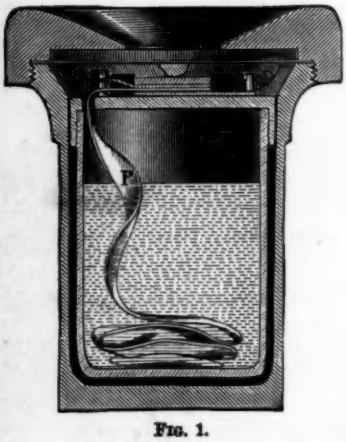

Fig. 1.

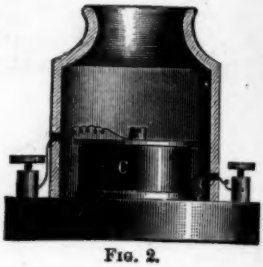

Fig. 2.

Fig. 3.

Fig. 4.

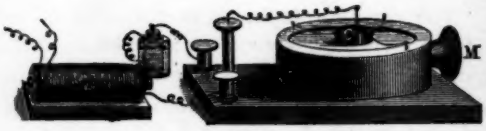

Fig. 5.

In Fig. 4 the pulverized plumbago, *P*, is floated upon mercury, *M*, and is compressed between the surface of the mercury and a metallic block fastened to the centre of the diaphragm.

Still another form of the Edison transmitter is shown in Fig. 5. The carbon, *C*, rests upon the diaphragm, which in this instrument is an horizontal plate forming the top of a vocalizing chamber, the mouth-piece being at the side.

Three fine cords attach the carbon to the framework of the diaphragm, and prevent it from being displaced when the diaphragm is vibrating. In appearance this instrument resembles the Reiss telephone, and in principle it would be much the same were it not that, in vibrating, the carbon never actually leaves the plate upon which it rests, but simply for an instant releases its pressure. It is evident that the resistance of the circuit depends upon the electric connection between the carbon and the diaphragm, and that this connection depends

upon the pressure of the carbon, which is constantly changing when the diaphragm is in vibration.

Another form, acting on much the same principle, is illustrated by Fig. 6. It is called the inertia-telephone, though it is hardly certain that its action is to be attributed solely to inertia. The carbon, *C*, is placed between two metallic plates, one of which is fastened to the diaphragm, and the other is held by a screw, bearing in a framework attached to the diaphragm by insulating supports.

FIG. 6.

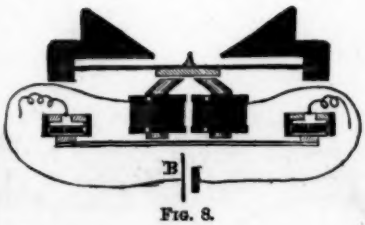

FIG. 8.

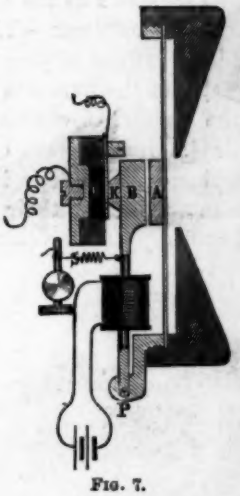

FIG. 7.

When vibrating, the whole system moves, instead of the plate *P* alone, as in the ordinary carbon-transmitter. Mr. Edison's explanation of its mode of action is, that the degree of pressure with which the carbon rests against the plates is varied during the vibration. Thus, after a movement toward the right, the diaphragm suddenly stops and the carbon presses, in virtue of its inertia, on the plate *P*.

An advantage which the magneto-telephone has over the carbon-telephone is that its diaphragm does not touch anything, and can therefore vibrate with perfect freedom. On the other hand, the diaphragm of the carbon-telephone presses with considerable force upon the carbon. In the form shown in Fig. 7 this difficulty is not encountered.

The diaphragm carries an armature, *A*, of soft iron, which confronts but does not touch the magnet *B*. *A* and *B* are opposite poles of the same magnet, being connected at *P* and polarized by a local circuit. The magnet *B* presses upon the carbon at *C*, the pressure

being regulated by the screw *S*. The attraction between *A* and *B* varies with the distance between them. When, in vibrating, *A* moves toward *B*, the attraction rapidly increases, and *B* lessens its pressure upon *C*. During a motion in the opposite direction the attraction diminishes, and *B*, drawn by the screw *S*, increases its pressure upon *C*.

A similar contrivance is illustrated in Fig. 8. The diaphragm carries an armature, *A*, which by its motion changes the potential of two electro-magnets. These changes in magnetism cause a bar situated in their magnetic field to reproduce the original vibrations. The ends of the bar are held by magnetic force against two pieces of carbon, *c* and *c*. These and the bar are included in the primary circuit of an induction-coil. The resistance of the circuit decreases when the bar is drawn up, and increases as the bar descends.

THE MICROPHONE.—The device of using several pieces of the semi-conductor instead of one was early tried by Mr. Edison. He found in general that the loudness of the sound was increased by thus multiplying the number of contact-surfaces, but also that the articulation was impaired. Instruments of this nature have since become known as microphones, though it is not probable that faint sounds were ever augmented through their agency. Fig. 9 shows one of the first forms of the microphone, invented by Mr. Edison, April 1, 1877. Four pieces

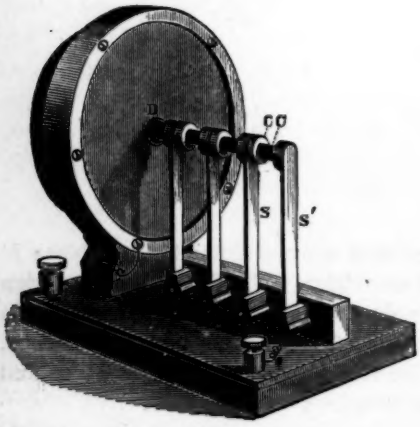

FIG. 9.

FIG. 10.

FIG. 11.

of charcoal are used, *C C*, etc., each supported by an upright spring, as at *S* and *S'*. The piece of charcoal nearest the diaphragm impinges upon a disk of carbon, which is fastened to the centre of the diaphragm. The primary wires of an induction-coil are attached to the diaphragm and the spring *S'*. The circuit is then completed through the semi-conductors. Other forms are shown in Figs. 10 and 11. The former has two carbons, separated by a plate of metal. The latter has three contiguous pieces of carbon.

Fig. 12 illustrates a microphone having ten plates of silk, a mixture of dextrine and lampblack having been previously worked into the pores.

In Fig. 13 fifty disks, *D*, of protoxide of iron, are shown inclosed in a glass tube.

A novel form of transmitter, used by Mr. Edison in his experiments, is shown in Fig. 14. The semi-conductor is a collection of small frag-

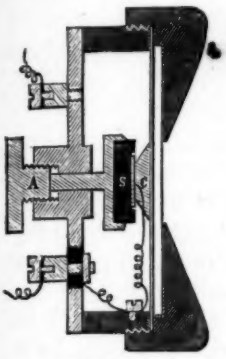

Fig. 12.

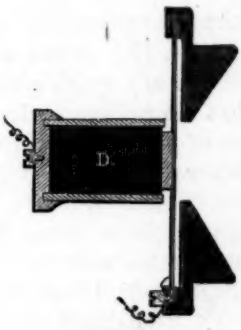

Fig. 13.

Fig. 14.

ments of cork, covered with plumbago. It can be used with or without a diaphragm.

The instrument shown in Fig. 15 acts both as a transmitter and receiver. The solid carbon of the transmitter is here replaced by silk fibres coated with graphite. Its action as a receiver is probably due to the attraction of parallel currents; the volume of the whole being contracted during the passage of a current through *F*.

In the accounts which have been published of experiments with the microphone, the statement has frequently been made that minute sounds are actually magnified by it, in the same sense that minute objects are magnified by the microscope. A little reflection will show, however, that there is no real analogy in the action of the two instruments. The sound that is heard in the receiving-instrument of the microphone, when a fly is walking across the board on which the transmitter is placed, is not the sound of the fly's footsteps, any more than the stroke of a powerful electric bell, or sounder, is the magnified sound of the operator's fingers tapping lightly, and it may be inaudibly, upon the key. This view of the subject readily explains why the microphone has failed to realize the expectations of many persons, who, upon its first exhibition, enthusiastically announced that by its aid we should be able to hear many sounds in Nature which had hitherto remained wholly inaudible.

Short-Circuiting Telephones.—A number of the telephones invented by Mr. Edison may be classed together as short-circuiting or

cut-out telephones. The principle upon which they act may be thus briefly stated: In vibrating, the diaphragm cuts from the circuit resistances which are proportional to the amplitude of the vibrations. A transmitter constructed upon this principle is shown in Fig. 16. A lever, *L*, of metal, vibrating in a vertical plane, rests at one end upon a strip of carbonized silk, *C*, which is part of the primary circuit of the induction-coil *I*. In the course of its vibrations the lever cuts from the circuit parts of the silk, the current passing temporarily through the lever.

Another, acting on the same principle, but differing considerably in construction, is shown in Fig. 17. A fine wire, *W*, of high resistance, is wrapped around a cylinder in a spiral groove.

The wire forms part of the primary circuit of the coil *C*. A spring, *S*, of metal, in the form of an ellipse, is fastened at one side to the diaphragm, while the other side presses against the uninsulated wire upon the cylinder. The diaphragm, in moving toward the right, flattens the spring, making it impinge upon a greater number of convolutions than it would if the motion were in the opposite direction. The resistance of the circuit depends, therefore, upon the position of the centre of the diaphragm. The disadvantage of this arrangement is, that either a whole convolution or none at all is suppressed from the circuit, rendering the current rather more intermittent than pulsatory.

In Fig. 18 a similar spring rests upon a narrow strip of metal on the surface of a glass plate. The film is shown in perspective at *F*, and consists of a fine strip of the silvered surface of a mirror, the rest of the burnished metal having been removed.

The action of this instrument is similar to that of the instrument shown in Fig. 16.

Still another form of short-circuiting telephone is shown in Fig. 19. A spiral spring, *W*, is wrapped about a cylinder, the diaphragm pressing against the last turn, so that in vibrating the convolutions approach or recede from each other. A very slight motion of the diaphragm is sufficient to cause the first few coils to come together; and in general the number of coils that thus touch each other is dependent upon the amplitude of the diaphragm's motion. The wire is included in the primary circuit of an induction-coil, so that the resistance of the circuit fluctuates as the diaphragm vibrates.

Condenser-Telephones.—Telephones in which static charge, instead of current strength, is made to vary in unison with the vocal utterances, have also been tried with success by Mr. Edison. The forms shown in Figs. 20 and 21 differ only in construction, not in principle.

The former consists of a circular vocalizing chamber, with mouthpiece at *V*. The chamber is surrounded with plates, which are connected with each other and to the ground. These plates are free to vibrate, and are shown in the figure in section, as at *P'*. Immediately

behind each of these stands a similar plate as at *P*, held at its centre by an adjusting screw. The outside row of plates is electrically connected with each other and with the battery, which goes to the line.

Fig. 15.

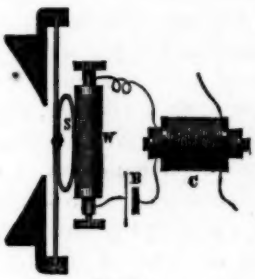

Fig. 17.

Fig. 18.

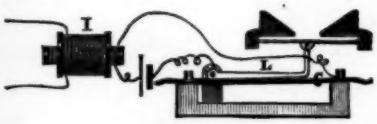

Fig. 16.

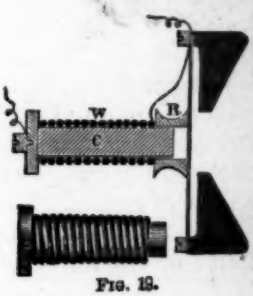

Fig. 19.

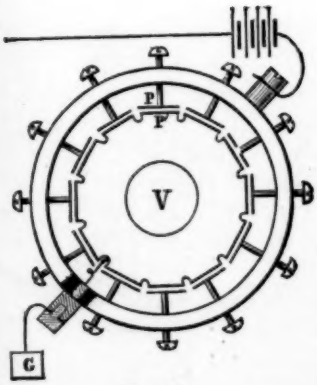

Fig. 20.

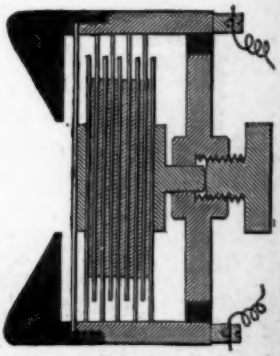

Fig. 21.

When the inside row of plates vibrates under the influence of a sound, the distance between the plates varies and changes their static capacity.

In Fig. 21 the plates are arranged as in the ordinary form of a condenser. An initial pressure is put upon them by a screw passing

through a portion of the solid frame of the instrument. The diaphragm in vibrating varies the distance between the plates. This alters their static charge, and affects also the electric tension of the line. The resistance of a conductor is dependent upon its shape. If an isometric block of metal be drawn out into a wire, its resistance may be indefinitely increased. This fact lies at the basis of several ingenious telephones invented by Mr. Edison. The one shown in Fig. 22 is of exceedingly simple construction. A globule of mercury, *M*, rests upon a slightly concave plate of metal. A needle from the diaphragm indents its upper surface, and, as it vibrates, slightly alters the shape of the globule. This alteration, though exceedingly small, is sufficient to vary the resistance of the telephonic current considerably.

It is a peculiar characteristic of a globule of mercury that it changes its original shape during the passage of a current through it. Mr. Edison has made an application of this phenomenon in the telephone-receiver shown in Fig. 23. The globule of mercury, *M*, is placed, together with a conducting solution, in a V-shaped tube. The currents from a transmitter, passing through the contents of a tube, elongate the mercury. This agitates the liquid and vibrates the float *F*, which is fastened to the centre of the diaphragm.

THE VOLTAIC PILE TELEPHONE.—We have shown in Fig. 24 an instrument known as the pile-telephone. A piece of cork, *K*, fastened to the diaphragm, presses upon a strip of platinum which is attached to a plate of copper. The latter is one of the terminal plates of an ordinary voltaic pile. The other terminal plate presses against the metallic frame of the instrument. When the pile is included in a closed tele-

FIG. 22.

FIG. 23.

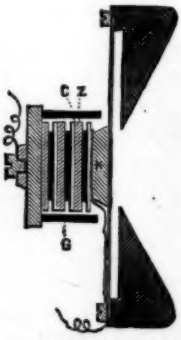

FIG. 24.

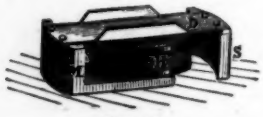

FIG. 25.

phonic circuit, it furnishes a continuous current. The strength of this current depends upon the internal resistance of the pile, and the latter is varied by vibrating the diaphragm.

A convenient and peculiar form of receiver used by Mr. Edison is

shown in Fig. 25. It is like the ordinary magneto-telephone, except that the circular diaphragm is replaced by a strip of thin iron, the edges having been bent so as to render it stiff. We mention it, simply because it demonstrates the fact that it is not essential that the diaphragm be circular.

A novel and purely mechanical telephone is illustrated by Fig. 26. In place of a line-wire, the illuminating gas, contained in gas-pipes, is used. It is calculated for short distances only, as it is essential that

Fig. 26.

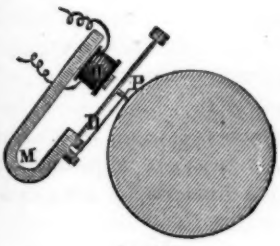

Fig. 27.

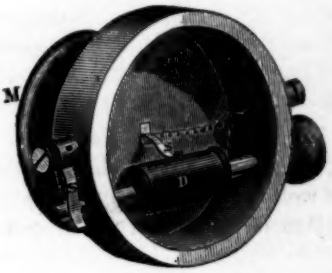

Fig. 28.

the gas used in communicating offices should be drawn from the same main pipe. In the figure, *P* is the main pipe. The telephones are represented at *T* and *T'*. The instrument is merely a cone fastened by its apex to the gas-pipe in place of the burner. The larger end is closed by a thin circular diaphragm. The vibrations are conveyed from one diaphragm to another through the medium of the gas.

The phonograph and telephone, when combined, form an instrument known as the telephonograph, of which Fig. 27 is a representation. The drum of the phonograph is shown in section. The diaphragm, instead of being vibrated by the voice, is vibrated by the currents which traverse the helix, *H*, and which originate at a distant station. The object of the instrument is to obtain a record of what is said at the distant office, which can be converted into sound when desired.

The Motograph.—The motograph-receiver, from which we have been accustomed to hear sounds almost destitute of quality, has, by a little modification, become an articulating telephone. It works quite well in conjunction with the Edison carbon-transmitter. In Fig. 28 the back of the motograph-receiver has been removed, showing its construction. Within the drum *D* is contained the decomposing solution,

and the covering surrounding the drum is kept constantly moits by capillary action. A metallic spring attached to the centre of the diaphragm rests upon the drum; while receiving, the drum is revolved by turning the milled screw at *A*.

A new transmitter for the motograph is shown in Fig. 29. The point *P*, projecting from the centre of the diaphragm, impinges upon a wrapping of plumbagoed silk, covering a small drum capable of adjustment by a thumb-screw.

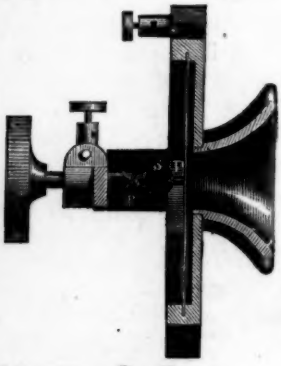

FIG. 29.

THE CARBON-RHEOSTAT. — A very important application of the property possessed by semi-conductors of changing their resistance under varying pressure, is shown in Fig. 30. The cut represents the new Edison carbon-rheostat. The instrument is designed to replace the ordinary adjustable rheostats whenever a resistance is to be inserted in a telegraph-line; as, for example, in balancing quadruplex circuits.

Fig. 31 is a vertical section. It shows a hollow cylinder of vulcanite, containing fifty disks of silk that has been saturated with sizing, and well filled with fine plumbago and dried. These are surmounted by a plate of metal, *C*, which can be raised or lowered by turning the

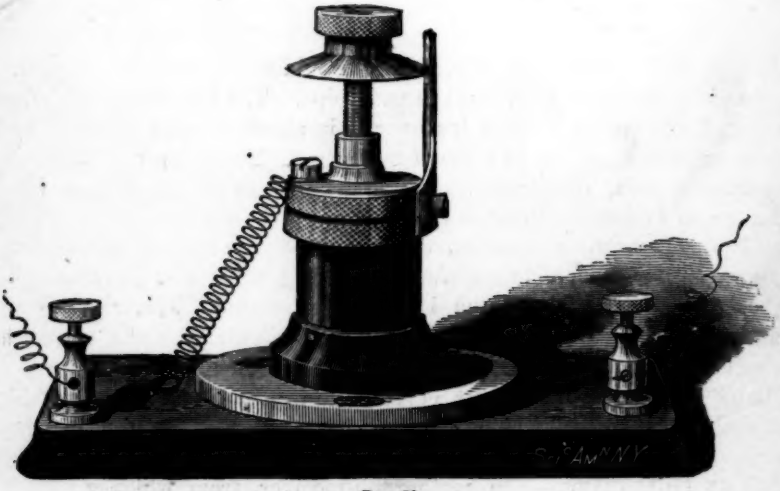

FIG. 30.

screw *D*. The carbon-disks can thus be subjected to any degree of pressure at pleasure. When inserted in the line, it is a matter involving no loss of time to obtain any desired resistance. The resistance can be varied from 400 to 6,000 ohms.

THE TASIMETER.—Fig. 32 shows in perspective the latest form of the Edison microtasimeter, or measurer of infinitesimal pressure. The value of the instrument lies in its ability to detect small variations of temperature. This is accomplished indirectly. The change of temperature causes expansion or contraction of a rod of vulcanite, which changes the resistance of an electric circuit by varying the pressure it exerts upon a carbon-button included in the circuit. During the total eclipse of the sun, July 29, 1878, it successfully demonstrated the existence of heat in the corona. It is also of service in ascertaining the relative expansion of substances due to a rise of temperature.

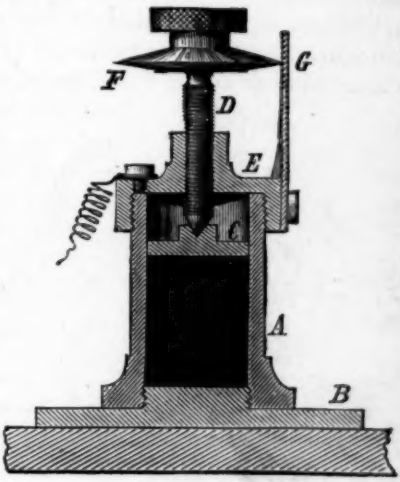

FIG. 31.

In Fig. 33 the important parts are represented in section, affording an insight into its construction and mode of operation.

The substance whose expansion is to be measured is shown at *A*. It is firmly clamped at *B*, its lower end fitting into a slot in the metal

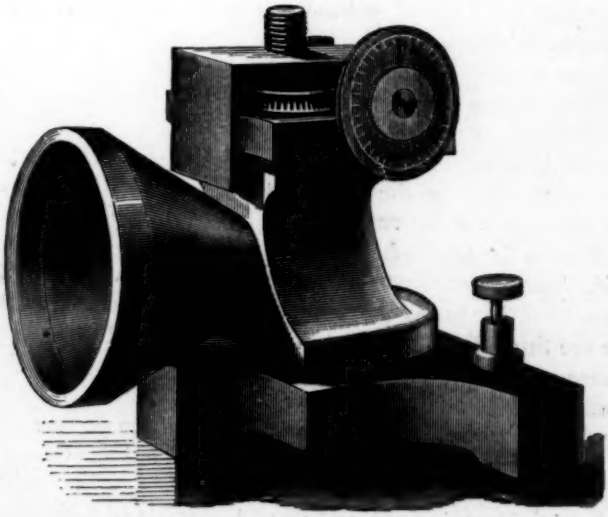

FIG. 32.

plate, *M*, which rests upon the carbon-button. The latter is in an electric circuit, which includes also a delicate galvanometer. Any variation

in the length of the rod changes the pressure upon the carbon, and alters the resistance of the circuit. This causes a deflection of the galvanometer-needle—a movement in one direction denoting expansion of *A*, while an opposite motion signifies contraction. To avoid any deflection which might arise from change in strength of battery, the tasimeter is inserted in an arm of the Wheatstone's bridge.

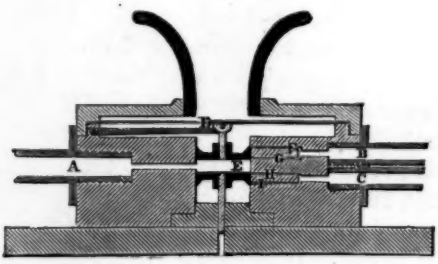

FIG. 33.

In order to ascertain the exact amount of expansion in decimals of an inch, the screw *S*, seen in front of the dial, is turned until the deflection previously caused by the change of temperature is reproduced. The screw works a second screw, causing the rod to ascend or descend, and the exact distance through which the rod moves is indicated by the needle, *N*, on the dial. The instrument can also be advantageously used to measure changes in the humidity of the atmosphere.

In this case the strip of vulcanite is replaced by one of gelatine, which changes its volume by absorbing moisture.

THE AREPHONE.—The arephone, an invention of Mr. Edison's, for amplifying sound, has already attracted considerable attention, though as yet it has not been perfected.

Its object is to increase the loudness of spoken words, without impairing the distinctness of the articulation.

The working of the instrument is as follows: The magnified sound proceeds from a large diaphragm, which is vibrated by steam or condensed air. The source of power is controlled by the motion of a second diaphragm, vibrating under the influence of the sound to be magnified.

There are three distinct parts to the instrument:

A source of power—compressed air.

An instrument to control the power.

A diaphragm vibrating under the influence of the power.

The first of these is usually compressed air, supplied from a tank. It is necessary that it should be of constant pressure.

The second, shown in section at Fig. 34, consists of a diaphragm and mouth-piece, like those used in the telephone. A hollow cylinder is attached by a rod to the centre of the diaphragm. The cylinder, and its chamber, *E*, will therefore vibrate with the diaphragm.

A downward movement lets the chamber communicate with the outlet *H*, an upward movement with the outlet *G*. The compressed air enters at *A*, and fills the chamber, which, in its normal position, has no outlet. Every downward vibration of the diaphragm will thus con-

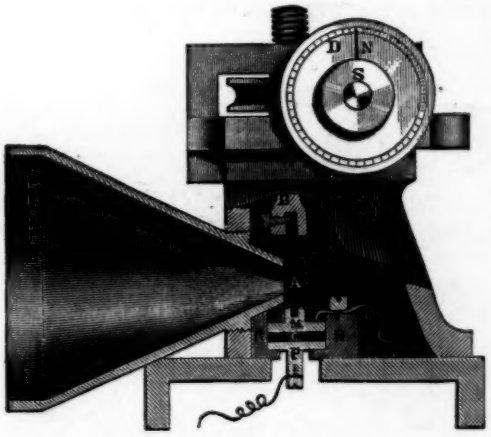

FIG. 34.

dense the air in the pipe *C*, at the same time allowing the air in *B* to escape *via F*. An upward movement condenses the air in *C*, but opens *I*.

The third and last part is shown in section in Fig. 35. It consists of a cylinder and piston, *P*, like that employed in an ordinary engine.

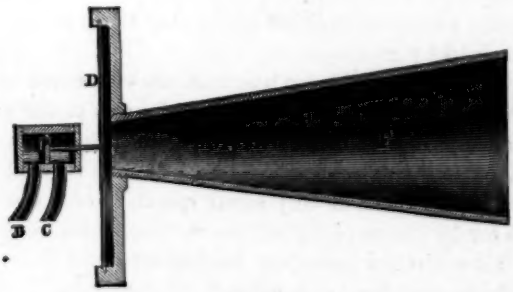

FIG. 35.

The piston-rod is attached to the centre of a large diaphragm, *D*. The pipes *C* and *B* are continuations of those designated in Fig. 34 by the same letters. The pipe *C* communicates with one chamber of the cylinder, and *B* with the other. The piston, moving under the influence of the compressed air, moves also the diaphragm, its vibrations being, in number and duration, identical with those of the diaphragm in the mouth-piece.

The loudness of the sound emitted through the directing tube, *F*, is dependent on the size of the diaphragm and the power which moves it. The former of them is made very large, and the latter can be increased to many hundred pounds' pressure.

THE HARMONIC ENGINE.—This instrument is shown in Fig. 36. Mr. Edison claims that ninety per cent. of the power derived from the bat-

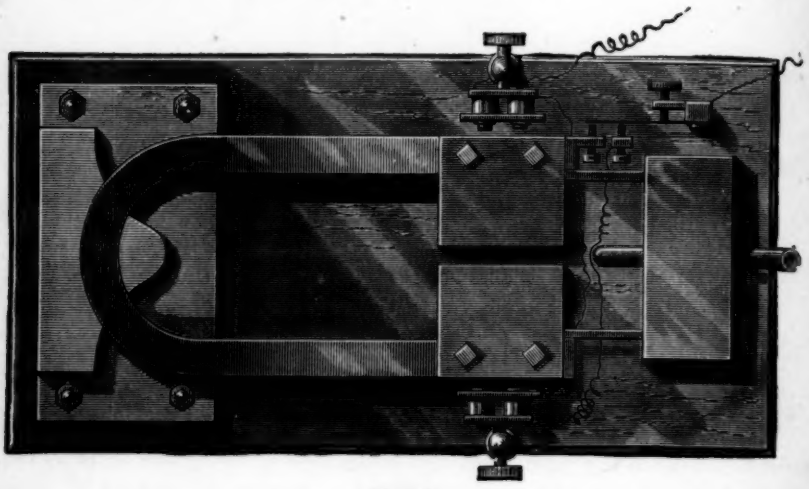

FIG. 36.

tery is utilized through its agency. The parts of the machine are: a tuning-fork of large dimensions, vibrating about thirty-five times a second, and carrying on each arm a weight of thirty-five pounds. The amplitude of the vibration is about one-eighth of an inch, and the vibrations are sustained by means of two very small electro-magnets, placed near the end of each arm. These magnets are connected in circuit with each other, and with a commutator worked by one of the arms.

Small branches extend from the fork-arms into a box containing a miniature pump having two pistons, one attached to each arm. Each stroke of the pump raises a very small quantity of water, but this is compensated for by the rapidity of the strokes. Mr. Edison proposes to compress air with the harmonic engine, and use it as a motor for propelling sewing-machines and other light machinery. It appears to be considerably in advance of other electric engines, and through its agency electricity may yet become a valuable motive-power.

FEVER-FACTORIES.

By F. L. OSWALD, M. D.

THE prediction of the *New Orleans Medical Journal*, that the vital and material losses of the Southern States by the last epidemic would exceed the costs of our Mexican War,[1] has been fully verified, but by its very magnitude the calamity may prove a less unqualified evil if it should help to open our eyes to the true nature and the origin of what has too long been considered a mysterious and unavoidable plague.

The hope of solving the riddle of the periodicity and topographical predilections of the fever-fiend suggested a careful comparison of the pathological statistics of our Spanish-American neighbors with those of our Southern lowlands; and these studies have revealed some curious facts, which the correspondents of our medical periodicals have corroborated rather than explained.

It appears that a disease which our ablest physicians have described as intensified malaria, has by no means confined itself to the malarious, i. e., swampy regions of the Atlantic slope, but in a great majority of cases may be traced to a city, or a well-drained but thickly-populated district, where the dietetic and domestic habits of the Caucasian race predominate over those of the American aborigines. Among many of the Indian tribes that inhabit the marshy lowlands and humid coast-forests of our continent, fevers are, on the other hand, wholly unknown; while Europeans who visit such regions, or natives who adopt European modes of life, become liable to a variety of enteric disorders.

Vera Cruz, *la Ciudad de los Muertos*, "the City of the Dead," as the Mexicans call it, on account of the frequency of its yellow-fever epidemics, is situated on a barren and extremely dry coast, remote from all swamps, and surrounded by arid sand-hills; while the natives of the peninsula of Yucatan, with its swamps and inundated virgin forests, are considered to be the healthiest and hardiest portion of the Mexican population. La Guayra, Caracas, and Santiago de Cuba, in spite of their mountainous environs, complain of the terrible regularity of their autumnal epidemics; but in the valley of the Amazon fevers were unknown before the arrival of the European colonists, and are still monopolized by the creoles and negroes of the larger settlements. The forest tribes of the Madeira, says Bonpland, cautioned the mis-

[1] The territorial acquisitions of the United States in 1848 were achieved at a cost of 15,350 human lives, and a direct and indirect expense of $123,000,000—a sum which was more than repaid by the California revenues of the next ten years. Total deaths by yellow fever from August 5 to October 5, 1878, 17,012. Direct and indirect losses (without any prospective compensation) of the city of New Orleans alone, $16,000,000—about one-tenth of the loss total to the Mississippi Valley from Memphis to the Delta.

sionaries against the use of animal food, and warned them that it would produce a disease which, like original sin, could only be cured by baptism, i. e., frequent shower-baths and invocations of the Great Spirit; and Bernal Diaz tells us that the subjects of Montezuma were afflicted with an eruptive disease, more painful though less incurable than leprosy, but that fevers made their first appearance with the Spaniards, and were long limited to the district of Toltepec (in the valley of Anahuac) and the Spanish quarter of the city of Tlascala.

In our cotton States, too, Baton Rouge, Vicksburg, and Memphis, on their high and dry bluffs, and Chattanooga, at an elevation of seven hundred feet above the level of the Gulf, have suffered more in proportion to their population than any place this side of Vera Cruz; while the swamps of the Red River and the Arkansas bottom-lands had not much to complain of besides their chronic "chills," and the *ne-plus-ultra* swamp, called Florida, has been entirely spared.

It is also known that the miasmatic virulence of alluvial districts is aggravated by excessive moisture and diminished by dry seasons, especially long, dry summers, which convert festering bogs into harmless steppes, and confine the swamp-belt of large rivers to a narrow strip along the lower shores. Now, if yellow fever, typhus, and cholera, were depending upon what physicians call telluric causes, i. e., the condition of the soil, in our more or less immediate neighborhood, wet years would be the most dangerous, whereas experience shows that, on the contrary, epidemics generally follow upon dry, hot summers, like the last and those of 1873 and 1868. These facts, which agree with the experience of the remotest countries and times, only confirm what dietetic reasons might indicate *a priori*, viz., that the so-called zymotic diseases have subjective rather than objective causes: they are produced by the unhealthy condition, not of the country so much as of the inhabitants, and originate in dry cities oftener than in swampy forests.

During the long centuries of the *Juventus Mundi*, forests and swamps were almost synonyms, as they still are in the lower latitudes of America and Eastern Asia. Animal life swarms and revels in such regions. Herbivorous and carnivorous animals, and our cousins the anthropoid apes, thrive in the moist woodlands of the torrid zone, and the Asiatic Malays, the natives of Soodan and Senegambia, and the aborigines of our own continent, have inhabited the swampiest districts of the tropical bottom-lands for ages with perfect impunity. They do not employ any of the antidotes by which the stranger hopes to secure himself against what he calls climatic influences, and that their immunity is not the inherited privilege of a special race is demonstrated by the diseases of the Mexican Indians, who have adopted the diet of their Spanish masters, and of the West African negroes, who have been carried to the far less swampy islands of the West Indian Archipelago. Dietetic differences alone can, therefore, furnish a logical

explanation, and these differences may be comprised in a few words: the savages of the tropics avoid calorific food.

Like their next neighbors, the Hindoos, the natives of Siam and the Sunda-Islanders are mostly frugivorous. Rice, fruits, nuts, and milk, constitute their principal diet, and only famine can reduce them to the use of animal food; they eschew the sudorific drinks of their European masters, and their only stimulant is a cooling alkaloid, the coagulated juice of the betel-nut palm, which they chew with an admixture of shell-lime. The mountaineers of Abyssinia and the inhabitants of the chilly South African highlands are carnivorous; but the natives of Guinea and Soodan, like the Arabs of the Desert, keep cattle and sheep for the sake of their milk, and use their flesh only in times of scarcity or in war. Our Spanish neighbors divide the copper-colored race into two well-defined classes, the *Indios Mansos* and the *Indios Bravos*, "the tame and ferocious Indians:" the first the frugal, Hindoo-like inhabitants of the coast-forests from Yucatan to Peru; the second the cruel hunters of men and beasts, who roam the wilds of the great West and the table-lands of Northern Mexico and Patagonia. The *Indios Mansos* of Yucatan, for instance, live on bananas, corn-cakes, brown beans fried with a little butter or palm-oil, and the abundant berries and nuts of their native forests, and enjoy an exceptional longevity and freedom from all sicknesses whatever, in all of which respects they resemble the ancient Peruvians, who had no physicians, as Devega remarks, because their only sickness was an incurable one—old age.

Instinct teaches these savages what our science seems to have forgotten, viz., that we must not aggravate the effects of atmospheric heat by calorific artifices. Almost all the domestic habits which distinguish the weaving and house-building Caucasian from the naked savage were originally precautions against the inclemency of a frigid latitude; and it is perhaps the greatest mistake of modern civilization that these precautions have become permanent institutions, instead of being confined to the winter season and occasional cold nights in April and October. We counteract the effects of a low temperature by artificial supplements to our native skin, by weather-proof buildings and heat-producing food, and with such success that De Quincey could define comfort as a supper eaten at leisure in a chimney-corner during the fiercest storm of a November night; but, when the dog-star rules the season, these factitious comforts turn to a very positive misery, and the same contrivances that shelter us against the fury of the snow-storm exclude the breezes that would temper the glow of the summer sun.

All the conventional, anti-natural customs of our social life, and all the prejudices of our prudish morality, seem to conspire to make the sunny half of the year as uncomfortable as possible. In a temperature that makes us envy the external lungs of the zoöphytes, and seethes

our veins till we would gladly part with our hereditary cuticle, custom obliges us to invest ourselves in double and threefold garments—air-tight if not water-proof, some of them—which intensify the effects of the atmospheric heat by the retained animal warmth of our own bodies, and confine, not perspiration, but the benefits of perspiration, to the small uncovered portion of our skin.

Our cities are atmospheric bake-ovens. They exclude the horizontal air-currents that sweep freely through the shady arcades of the forest, but they admit sunlight and retain their self-created heat, their dust, and their sudorific vapors. We have inherited the antique passion for whitewashed houses and stone fences that reflect the sun's rays with a distressing glare, while we have abolished the intramural gardens and free public baths that alleviated the summer sufferings of the ancient Mediterranean cities; but our hyperborean diet is perhaps a still more prolific source of evil.

The experience of all tropical and sub-tropical nations has taught them to avoid animal food and fat, and to counteract the influence of a sultry climate by cooling, non-stimulating drinks and fruit, for a three or four years' neglect of these precautions is sure to undermine the soundest constitution, as demonstrated by the fate of countless employés of the East Indian administration, who left Great Britain as models of Saxon or Celtic *vis virilis*, and returned as tremulous invalids after a few hundred beefsteak-and-ale dinners in the atmosphere of the Lower Ganges Valley. The advent of our autumnal night frosts and bracing north winds saves most of us from the ultimate consequences of this East Indian malady, but not one man in a thousand escapes the *pro tempore* penalties of living through the tropical quarter of the solar year as if he were fighting the battle of life against an arctic snow-storm. Cold air is a tonic and antiseptic, and under its influence many substances which Nature never intended for our food become healthy or at least digestible, for a Kamtchatka fisherman can swallow as his daily ration a dose of blubber and brandy that would kill seven Hindoos. The pork-steaks and bitters that feed the fire of life in December smother it in August like so much incombustible rubbish, or evolve fumes that obscure its brightness, till we yearn for the equinoctial gale like a becalmed mariner in a fog, or take refuge from hypochondria in the summerless heights of a mountain-region; and, if starvation were not so often superadded to the cold and the darkness of the season of short days and long nights, it would be very doubtful if the bitterest winter sorrows of the children of Nature could compare with the self-inflicted summer martyrdom of a European or North American dyspeptic. For languor, dull headaches, nausea, and troubled dreams, though singly and momentarily no very serious evils, can aggregate in a sum of misery that has induced all northern nations to make a high temperature the chief characteristic of the pit of torment.

The antidotal resources of Nature counteract the evil for a while; diarrhœa, retching, and intermittent fevers, discover her efforts to secrete an indigestible substance; the suicidal diet is modified, in quantity at least, by nausea and loss of appetite, and the periodical north winds that reduce the summer temperature of our Southern States by twenty or thirty degrees may help to postpone the crisis for weeks and months. But if that palliative fails, and the devotee of established customs pursues his course with intrepid fanaticism, the barriers of life yield at last, and Nature ends an evil which she cannot cure. The direct cause of yellow fever is the inability of the vital power to withstand the double influence of moist heat from within and without.

In all zymotic diseases the blood passes through the incipient stages of fermentation, incited, perhaps, by floating animal or vegetable germs, but favored by and depending upon the enteric condition of each individual. The morbid humors begin to ferment,[1] the progress of decomposition separates the red blood-globules from the serum; the first accumulate in the digestive apparatus and are discharged in that vomit of cruor which marks the advanced stages of yellow fever and cholera, while the absence of the coloring particles from the circulating blood tinges the skin with a yellowish hue. The convulsion of the bowels reacts on the brain, produces violent headaches, coma, perhaps, or delirium, and paroxysms of nausea, and ends by utter exhaustion and death. It is notorious that the bodies of the victims of yellow fever need immediate interment on account of the swiftness with which putrefaction begins, or rather ends, its work.

As its name implies, a fever epidemic is a contagious disease, and it cannot be denied that by prompt removal from the infected atmosphere innumerable candidates of the winding-sheet might be saved; but it is quite as certain that even persons of a frail constitution, but innocent of dietetic sins, may breathe with impunity the air in which thousands of their stricken fellow-citizens have recently expired. Everywhere the mortality lists show a great preponderance of males over females, of men of sedentary pursuits over open-air laborers, and of epicures over ascetics. Catholic seminarists, Sisters of Charity, vegetarians, and tramps, have enjoyed a remarkable immunity, owing to their voluntary or involuntary habits of abstinence. Worried physicians, spectral old spinsters, and smoke-dried presbyters, have generally survived, while corpulent beer-brewers, lusty landlords, and chubby butcher-boys, went down like grass under a sweeping scythe; and the local papers of New Orleans and Vicksburg have repeatedly called attention to the fact that the business-men who declined to close either their earthly career or their stores were mostly Italians and Jews.

The lessons of the last epidemic find numerous precedents in the

[1] That the blood-changes in zymotic diseases are *catalytic* is sufficiently proved by the prophylactic power of cold and of the same antiseptics that would arrest an inchoate process of fermentation.

history of former times. The *black-death* that ravaged Asia and Southern Europe in the fourteenth century spared the Mohammedan countries—Persia, Turkistan, Morocco, and Southern Spain—whose inhabitants generally abstained from pork and intoxicating drinks. In the Byzantine Empire, Russia, Germany, France, Northern Spain (inhabited by the Christian Visigoths), and Italy, 4,000,000 died between 1373 and 1375, but the monasteries of the stricter orders and the frugal peasants of Calabria and Sicily enjoyed their usual health (which *they*, of course, ascribed to the favor of their tutelar saints); but among the cities which suffered most were Barcelona, Lyons, Florence, and Moscow, the first three situated on rocky mountain-slopes, with no lack of drainage and pure water, while the steppes of the Upper Volga are generally dry and salubrious.

The pestilence of 1720 swept away 52,000, or more than two-thirds of the 75,000 inhabitants of Marseilles, in less than five weeks; but of the 6,000 abstemious Spaniards that inhabited the "Suburb of the Catalans" only 200 died, or less than four per cent. The most destructive epidemic recorded in authentic history was the four years' plague that commenced in A. D. 542 and raged through the dominions of Chosroes the Great, the Byzantine Empire, Northern Africa, and Southwestern Europe. It commenced in Egypt, spread to the east over Syria, Persia, and the Indies, and penetrated to the west along the coast of Africa and over the Continent of Europe. Asia Minor, with its plethoric cities, Constantinople, Northern Italy, and France, suffered fearfully; entire provinces were abandoned, cities died out and remained vacant for many years, and during three months 5,000 and at last 10,000 persons died at Constantinople *each day!* (Gibbon's "History," vol. iii., chap. xliii.); and the total number of victims in the three continents is variously estimated from 75,000,000 to 120,000,000 (Procopius, "Anecdot.," cap. xviii.; Cousin's "Hist.," tome ii., p. 178). But in Sicily, Morocco, and Albania, the disease was confined to a few seaport towns, and the Caucasus and Arabia escaped entirely.

This dreadful plague made its first appearance in Alexandria, Egypt, then a luxurious city of 800,000 inhabitants, and Paulus Diaconus, a contemporary historian, speaks of the "reckless gluttony by which the inhabitants of the great capital incurred yearly fevers and dangerous indigestions; and at last brought this terrible judgment upon themselves and their innocent neighbors" (lib. ii., cap. iv.). Alexandria lost half a million of her inhabitants in 542, and 80,000 in the following year, and for miles around the city the fields were covered with unburied corpses; but the monks of the Nitrian Desert (3,000 of them had devoted themselves to the task of collecting and burying the dead) lost only fifty of their fraternity, who with few exceptions confessed that they had secretly violated the ascetic rules of their order.

If the thirteen centuries since that year of judgment had been employed in the study of physiology and hygiene rather than in Trinita-

rian and Monophysite disputes and transubstantiation controversies, we might know by this time that the repetition of the excesses of the Egyptian capital in an Egyptian climate will always provoke an Egyptian plague, and that the observance of some simple dietetic rules would insure our health against the most malignant climatic influences. Southern cities like New Orleans, Memphis, and Galveston, that consume from 500 to 5,000 barrels of pork and four times as many kegs of lager-beer and gallons of whiskey each summer day, while they confine forty or fifty per cent. of their population in stifling tenement-houses, schoolrooms, and workshops, and, instead of providing free public baths, legislate against river-bathing within their corporate limits—such cities, whether situated in the swamps, like New Orleans, or on dry hills, like Memphis, are fever-factories, and produce epidemic diseases by the use of calorific food in a sweltering climate, as systematically as the New Orleans ice-factory evolves cubes of congealed water by the evaporation of ether in and around its copper water-tanks.

To our dietetic abuses and the deficient ventilation of our buildings and *bodies*, we can ascribe the fact that the average mortality of the half-year from June to November exceeds that of the remaining six months by twenty per cent. on the table-lands and by more than thirty per cent. along the sea-coasts of the two Caucasian continents; but this increase of the death-rate is only a small part of the sum total of our self-caused summer martyrdom. If we could weigh the nameless discomforts, the weariness, the physical and moral nausea, and the unsatisfied hunger after the life-air and freedom of the wilderness, endured by millions of factory-children, shopkeepers, and counting-house drudges, if we could weigh all their misery against the hardships of the savages and half-savage nomads, we might agree with the Benthamites, that, measured by the criterion of the greatest happiness of the greatest number, modern civilization is a very indifferent success. "There is something pathetic in every suicide," says Montesquieu, "for the fact that life had become insupportable to a human being could not be more conclusively proved." But the same fact is proved by every premature death, for the destructive agencies of Nature never assert themselves till the evils of life outweigh its blessings. When Vishnu resigns his power to Shiva we may be sure that annihilation is the more merciful alternative.

A privileged small minority, some happy few among the upper ten per cent. of our city population, can celebrate the holidays of their luxurious year, when rising thermometers, dust-clouds, kitchen-fumes, woolen garments, and peppered ragouts, kindle the fires of Moloch in our veins; but what shall we do to be saved if poverty or duty prevent us to save ourselves by flight to the White Mountains? A century may pass before chemists invent the art of cooling our houses by an artificial process as cheaply and effectually as we warm them by fire,

but in the mean time we might restrict our calorific efforts to the eight coolest months of the year.

In the first place we might curtail the number of our warm meals, or cook them on the coöperative plan in a separate building, where ten or twelve families could use a common stove and a joint stock of fuel and certain groceries, and thus save our sitting-rooms and studies from the effects which even a basement-kitchen fire exerts on the domestic atmosphere. Heat-producing food, too, might very well be dispensed with. The vegetarian school has demonstrated beyond the possibility of a doubt that farinaceous dishes, sweet milk, and fruit, are sufficient to maintain a hard-working man in perfect health, and such a diet might certainly be substituted for our greasy steaks and ragouts during the hottest weeks of the sultry season. Whether or not such mild stimulants as tea and coffee are preferable to pure water, it is certain that they are sudorific drinks, and that even their moderate use increases the temperature of our blood by several degrees during their passage through the digestive apparatus. Smoking-hot dishes and such spices as pepper, mustard, onions, and ginger, are liable to the same objection, and we should not forget that sultry weather retards the digestion of all fatty substances by several hours.

Cooling and non-stimulating drinks of a temperature of not less than 5° above the freezing-point might, on the contrary, be freely used in any enjoyable quantity, for the prevailing notions in regard to the danger of "cold drinks in the heat" prove nothing but the marvelous tenacity of popular superstitions. Like the prejudice against raw fruit, night air, and "draught" (i. e., the passage of a current of pure air through the vitiated air of a human dwelling), this notion has furnished a pretext for the strangest sanitary aberrations, and has been defended with the same ingenious sophistry that supplies the advertisers of patent nostrums with their specious arguments. To prevent cold water from "chilling our stomachs," we are advised to mix it with a few drops of brandy, to wash our wrists and let our faces cool off, or to chew a preliminary bread-crust; and parents solemnly warn their children not to endanger their health by gratifying an imprudent appetite.

But the craving of our heated system for a refrigerating beverage is a natural instinct which we share with all warm-blooded animals, and which manifests itself in children and savages as well as in adult and civilized men. We see horses, hounds, and stags, walk bodily into a cool river after a hot chase, or quench their thirst at a cold spring with perfect impunity; and the idea that Nature should thus tempt us to anything positively injurious implies a deplorable ignorance of the language of our *physical conscience.* Injurious things, as poisons, excessive heat, or excessive cold, are disagreeable; and whatever is agreeable is beneficial, unless instinct has been supplanted by artificial habits. It might, for instance, be said that the appetite of a drunkard tempts

him to indulge in a body and soul destroying poison, but that appetite has been artificially and painfully acquired, and in spite of the earnest protests of Nature, which teach a child by the unmistakable testimony of its senses that alcohol and all fermented drinks are disgusting, and consequently injurious. But cold water, cold sweet milk, lemonade, and cider fresh from the press, are agreeable to every undepraved palate, and of these and similar beverages we might drink our fill on the hottest day, without any fear of having to repent the gratification of a *natural* appetite. Persons, like Baron Brisse, who frankly admit that their only object in life is to diminish its tedium, act at least consistently if they adopt the most effectual means to shorten its duration, but housekeepers who, from motives of economy, grudge their children a handful of apples or an excursion to a shady picnic-ground, should not boast of their annual savings before they have deducted the doctor's bill.

To take plenty of rest after meals is another health rule which we might adopt on the authority of our instinct-guided fellow-creatures, if not of our sensible ancestors, who surpassed us in physical vigor and hygienic insight as much as we exceed them in mechanical or astronomical knowledge. In obedience to an urgent instinct, wild animals retire to their hiding-places after a hearty feed, and digest in peace; and the ancient Greeks, as well as the Romans of the ante-Cæsarean era, contented themselves with one daily meal, which they ate leisurely in the cool of the afternoon after completing their day's work. The rest of the evening they devoted to music, conversation, dances, and light gymnastics, and had thus all night, besides the larger part of the following day, for digestion, could assimilate their food, and probably derived more enjoyment from that one meal than we do from our hurried dinners, late suppers, luncheons, and "Christian breakfasts"—true *déjeuners dinatoires*, that dull our brains and limbs during the first three or four post-prandial business-hours.

For a quarter of a year, at least, we might get along with two daily meals, one at noon, after finishing the larger and harder half of our day's work, on an "empty stomach" (which custom would soon make a resigned and very comfortable stomach), then a *siesta* of three or four hours; work till sunset, and then a bath, followed by a leisurely symposium and such domestic amusements as our tastes and opportunities might suggest; and since it is probably true that sleep should not follow too close upon a large meal, we might prolong our amusements or *dolce far nientes* through the first third of the night, on Saturdays even till after midnight, without fear of thereby violating any law of Nature. The habits of our next relations among the children of the wilderness, the mammals, and vertebrate reptiles, become seminocturnal during the warm season: deer, buffaloes, antelopes, and kangaroos, graze in moonshine; bears and foxes leave their dens after dark and rest through the warmer part of the day; alligators wander about

on *terra firma* in warm nights, and frogs continue their serenades till the morning wind chills them into silence and somnolence. The drowsy heat of the afternoon invites to slumber as the cool hours before the noon of night invite to music, reverie, or sentimental conversation, and our midsummer-night dreams would be no worse for a moonlight ramble on the mountains or in the garden-suburbs of a large city.

But "the best of all things is water, after all," was Pindar's motto, and should be our motto in summer-time, in regard to pure cold water, externally applied. In the crowded cities of the Atlantic seaboard and the Lower Mississippi Valley, whose summer temperature equals that of southernmost Europe, the lot of the hard-working classes would be exceedingly improved by the institution of free public baths. The citizens of the Roman Empire regarded their *thermæ* and their *balnea publica* as the chief criterion of a civilized town; and it is strangely characteristic of the metaphysical and anti-natural tendency of our ethical system that not one of our wealthy philanthropists ever thought of promoting the welfare of his native city by an establishment which an enlightened community should value as a common necessity rather than as a luxurious privilege.

The baths of Caracalla, which furnished the means of physical purification to tens of thousands, were certainly as useful—practically and morally—as the Serapion or the temple of Jupiter Capitolinus; and one per cent. of the wealth that has been expended on churches, Sunday-schools, foreign missions, and other attempts to secure the *post-mortem* felicity of the masses, would suffice to make their terrestrial existence far more endurable.

EDUCATION AS A SCIENCE.

By ALEXANDER BAIN, LL. D.,
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VII.—THE EMOTIONS IN EDUCATION (*concluded*).

THE considerations stated in the previous article (*see* November Monthly) lead up to the final subject—Punishment; in administering which the practice of education, as well as of other kinds of government, has greatly improved. The general principles of punishment have been already renounced. We have to consider their application to the school. But first a few words on the employment of reward.

Emulation—Prizes—Place-taking.—All these names point to the same fact and the same motive—the desire of surpassing others, of gaining distinction; a motive that has already been weighed. It is the most powerful known stimulant to intellectual application; and,

where it is in full operation, nothing else is needed. Its defects are (1) it is an anti-social principle, (2) it is apt to be too energetic, (3) it is limited to a small number, (4) it makes a merit of superior natural gifts.

It is a fact that the human intellect has at all times been spurred to its highest exertions by rivalry, contest, and the ambition of being first. The question is, whether a more moderate pitch of excellence, such as befits average faculties, could not be attained without that stimulant. If so, there would be a clear moral gain. Be this as it may, there is no need to bring it forward prematurely, or to press its application at the beginning. In the infant stage, where the endeavor is to draw out the amicable sentiments, it is better kept back. For tasks that are easy and interesting, it is unnecessary. The pupils that possess unusual aptitude should be incited to modesty rather than to assumption.

The greater prizes and distinctions affect only a very small number. Place-capturing, as Bentham phrases it, affects all more or less, although in the lower end of a class position is of small consequence. Too often the attainments near the bottom are *nil.* A few contesting eagerly for being first, and the mass phlegmatic, is not a healthy class.

Prizes may be valuable in themselves, and also a token of superiority. Small gifts by parents are useful incitements to lessons; the school contains prizes for distinction that only a small number can reach. The schoolmaster's means of reward is chiefly confined to approbation, or praise, a great and flexible instrument, yet needing delicate manipulation. Some kinds of merit are so palpable as to be described by numerical marks. Next, in point of distinctness, is the fact that a thing is right or wrong, in part or in whole; it is sufficient approbation to pronounce that a question is correctly answered, a passage properly explained. This is the praise that envy cannot assail. Most unsafe are phrases of commendation; much pains is needed to make them both discriminating and just. They need to have a palpable basis in facts. Distinguished merit should not always be attended with pæans; silent recognition is the rule, the exceptions must be such as to extort admiration from the most jealous. The controlling circumstance is the presence of the collective body; the teacher is not speaking for himself alone, but directing the sentiments of a multitude, with which he should never be at variance; his strictly private judgments should be privately conveyed. Bentham's "scholar-jury principle," although not formally recognized in modern methods, is always tacitly at work. The opinion of the school, when at its utmost efficiency, is the united judgment of the head and the members, the master and the mass. Any other state of things is war: although this, too, may be unavoidable.

PUNISHMENT.—The first and readiest, and ever the best, form of punishment, is censure, reprobation, dispraise, to which are applicable

all the maxims above laid down for praise. Definite descriptions of definite failures, without note or comment, are a power to punish. When there are aggravations, such as downright carelessness, a damaging commentary may be added; but, in using terms of reprobation, still more strict regard has to be paid to discrimination and justice. The degrees of badness are sometimes numerical, as by the quantity of lesson missed, and the repetition of inattention; this very definiteness literally stated is more cutting than epithets.

Strong terms of reproof should be sparing, in order to be more effective. Still more sparing ought to be tones of anger. Loss of temper, however excusable, is really a victory to wrong-doers; although for the moment it may strike terror. Unless a man is of fiendish nature throughout, he cannot maintain a consistent course, if he gives way to temper. Indignation under control is a mighty weapon. Yet it is mere impotence to utter threats when the power of execution is known to be wanting. There is nothing worse for authority than to overvaunt itself; this is the fatal step to the ridiculous.

Whoever occupies a position of authority ought to be familiar with the general principles and conditions of punishment, as they may be found set forth in the penal code of Bentham. The broad, exhaustive view there given will coöperate beneficially with each one's actual experience. I make no apology for presenting a short summary of his principles.

After precisely defining the proper ends of punishment, Bentham marks the cases unmeet for punishment: 1. Where it is *groundless:* that is, where there never has been any real mischief (the other party consenting to what has been done), or where the mischief is overweighed by a benefit of greater value. 2. Where it is *inefficacious:* including cases where the penal provision has not come before the offender's notice, where he is unaware of the consequences of his act, or where he is not a free agent. 3. Cases where it is *unprofitable:* that is, when the evil of the punishment exceeds the evil of the offense. (The evils of punishment, which have to be summed up and set against the good, are (1) coercion or restraint, (2) the uneasiness of apprehension, (3) the actual suffering, (4) the suffering caused to all those that are in sympathy with the person punished.) 4. Cases where punishment is *needless:* as when the end can be attained in some cheaper way, as by instruction and persuasion. In this class Bentham specially includes the offenses that consist in disseminating pernicious principles in politics, morality, or religion. These should be met by instruction and argument, and not by the penalties of the law.

Under what he calls the expense or frugality of punishment, Bentham urges the necessity of presenting to the mind an adequate notion of what a punishment really is. Hence the advantage of punishments that are easily learned and remembered, and that appear greater and not less than they really are.

Next as to the main point, the *measure* of punishment: 1. It should be such as clearly to outweigh the profit of the offense: including not simply the immediate profit, but every advantage, real or apparent, that has weighed as an inducement to commit it. 2. The greater the mischief of the offense, the greater is the expense that it is worth while to be at, in the way of punishment. 3. When two offenses come into competition, the punishment for the greater should be such as to make the less preferred; thus robbery with violence to the person is always punished more severely than simple robbery. 4. The punishment to be so adjusted that, for every part of the resulting mischief, a motive may be provided to restrain from causing it. 5. The punishment should not be greater than is needed for these ends. 6. There should be taken into account the circumstances affecting the sensibility of the offenders, so that the same punishment may not operate unequally; as age, sex, wealth, position. 7. The punishment needs to be increased in magnitude as it falls short of certainty. 8. It must be further increased in magnitude as it falls short in point of proximity. Penalties that are uncertain and those that are remote correspondingly fail to influence the mind. 9. When the act indicates a *habit*, the punishment must be increased so as to outweigh the profit of the other offenses that the offender may commit with impunity: this is severe, but necessary, as in putting down the coiners of base money. 10. When a punishment well fitted in its quality cannot exist in less than a certain quantity, it may be of use to employ it, although a little beyond the measure of the offense: such are the punishments of exile, expulsion from a society, dismissal from office. 11. This may be the case more particularly when the punishment is a moral lesson. 12. In adjusting the quantum, account is to be taken of the circumstances that render all punishment unprofitable. 13. If, in carrying out these provisions, anything occurs tending to do more harm than the good arising from the punishment, that thing should be omitted.

In regard to the selection of punishments, Bentham lays down a number of tests or conditions whereby they are fitted to comply with the foregoing requirements: 1. The quality of *variability:* a punishment should have degrees of intensity and duration; this applies to fines, corporal punishment, and imprisonment, also to censure or ill-name. 2. *Equability*, or equal application under all circumstances: this is not easy to secure; a fixed fine is an unequable punishment. 3. *Commensurability:* that is, punishments should be so adapted to offenses that the offender may clearly conceive the inequality of the suffering attached to crimes of different degrees of heinousness; this property can be grafted on the variable punishments, as imprisonment. 4. *Characteristicalness:* this is where something can be found in the punishment whose idea exactly fits the crime. Bentham dilates upon this topic, in order to discriminate it from the old crude method of an eye for an eye; cases in point occur abundantly both in the family and

in the school. 5. *Exemplarity:* this is connected with the impressiveness of a punishment; all the solemnities accompanying the execution increase this effect. Bentham, however, did not sufficiently consider the evils attending too great publicity, which have led to withdrawing punishments from the gaze of the multitude; it being simply intimated that they have been carried out. 6. *Frugality:* or making punishments less costly to the state, as when prisoners are employed productively. 7. *Subserviency to reformation:* by weakening the seductive and strengthening the preserving motives; as in giving habits of labor to the idle. 8. *Efficacy in disablement:* as in deposition from office. 9. *Subserviency to compensation:* as by pecuniary inflictions. 10. *Popularity.* Bentham lays much stress upon the popularity and unpopularity of punishments, whereby the public sympathy may work for or against the law; when a punishment is unpopular, juries are reluctant to convict, and public agitation gets up for remission of sentence. 11. *Simplicity of description:* under this head Bentham comments upon the obscure and unintelligible descriptions of the old law, as *capital felony, præmunire.* 12. *Remissibility,* in case of mistake.

Punishments must go deeper than words; indeed, the efficacy of blame depends on something else to follow. Bearing in mind what are the evil tendencies to be encountered in school discipline—want of application being the most constant—we may review the different kinds of penalties that have been placed at the disposal of the schoolmaster. The occasional aggravation of disorder and rebelliousness has also to be encountered, but with an eye to the main requisite.

Simple forms of disgrace have been invented, in the shape of shameful positions and humiliating isolation. As appealing to the sense of shame, these are powerful with many, but not with all: their power varies with the view taken of them by the collective body, as well as with individual sensitiveness. They answer for smaller offenses, but not for the greatest; they may do to begin with, but they rapidly lose power by repetition. It is a rule in punishment to try slight penalties at first; with the better natures the mere idea of punishment is enough; severity is entirely unnecessary. It is a coarse and blundering system that knows of nothing but the severe and degrading sorts.

Detention from play, or keeping-in after hours, is very galling to the young; and it ought to suffice for even serious offenses; especially for riotous and unruly tendencies, for which it has all the merits of "characteristicalness." The excess of activity and aggressiveness is met by withholding the ordinary legitimate outlets.

Tasks or impositions are the usual punishment of neglect of lessons, and are also employed for rebelliousness; the pain lies in the intellectual *ennui,* which is severe to those that have no liking for books in any shape. They also possess the irksomeness of confinement and fatigue-drill. They may be superadded to shame, and the combination is a formidable penalty.

With all these various resources ingeniously plied—emulation, praise, censure, forms of disgrace, confinement, impositions—the necessity for corporal punishments should be nearly done away with. In any well-regulated school, where all the motives are carefully graded, through a long series of increasing privations and penalties, there should be no cases but what are sufficiently met. The presence of pupils that are not amenable to such means is a discord and anomaly; and the direct remedy would consist in removing them to some place where the lower natures are grouped together. Inequality of moral tone is as much to be deprecated in a class as inequality of intellectual advancement. There should be reformatories, or special institutions, for those that cannot be governed like the majority.

Where corporal punishment is kept up, it should be at the far end of the list of penalties; its slightest application should be accounted the worst disgrace, and should be accompanied with stigmatizing forms. It should be regarded as a deep injury to the person that inflicts it, and to those that have to witness it—as the height of shame and infamy. It ought not to be repeated with the same pupil; if two or three applications are not enough, removal is the proper course.

The misfortune is, that in the national schools the worst and most neglected natures have to be introduced; yet they should not brutalize a whole school. Even when children are habituated to blows at home, it does not follow that these are necessary at school; parents are often unskillful, as well as hampered in all their circumstances, and emergencies are pressing; the treatment at school may easily rise above the conduct of the family. In many instances the school will be a welcome haven to the children of troubled homes, and lead to the generous response of good behavior.

In point of fact, however, the children of wretchedness are not always those that give trouble, nor is it the schools where these are found that are most given to corporal punishments. The schoolmaster's most wayward subjects come often from good families; and they are found in schools of the highest grade. There should be no difficulty in sending away from superior schools all such as could not be disciplined without the degradation of flogging.[1]

[1] Testimonials are adduced from very distinguished men, to the effect that without flogging they would have done nothing. Melanchthon, Johnson, Goldsmith, are all quoted for a sentiment of this kind. We must, however, interpret the fact on a wider basis. There was no intermediate course in those days between spoiling and corporal punishment: he that spared the rod hated the child. Many ways can now be found of spurring young and capable minds to application; and corporal punishment would take an inferior position in the mere point of efficiency.

It is not to be held that corporal punishment, to such extent as is permissible, is the severest form of punishment that may be administered in connection with the school. For mere pain, a whipping would often be chosen in preference to the intolerable irksomeness of confinement during play or after hours, and of impositions in the way of drill-tasks; while the language of censure may be so cutting as to be far worse than blows.

THE DISCIPLINE OF CONSEQUENCES.—The idea of Rousseau that children, instead of being punished, should be left to the natural consequences of their disobedience, has much plausibility, and is taken up at the present day by educationists. Mr. Spencer has dwelt upon it with great emphasis.

One obvious limitation to the principle is, that the results may be too serious to be used for discipline: children have to be protected from the consequences of many of their acts.

What is intended is, to free parents and others from the odium of being the authors of pain, and to throw this upon impersonal agencies, toward whom the child can entertain no resentment. But, before counting on that result, two things are to be weighed. For one, the child may soon be able to see through the device, and to be aware that after all the pain is brought about by virtue of a well-laid scheme for the purpose: as when the unpunctual child is left behind. The other remark is that, the personifying or anthropomorphic tendency being at its greatest in early years, every natural evil is laid to the door of a person known or unknown. The habit of looking at the laws of Nature, in their crushing application, as cold, passionless, purposeless, is a very late and difficult acquirement, one of the triumphs of science or philosophy: we begin by resenting everything that does us harm, and are but too ready to look round for an actual person to bear the brunt of our wrath.

A further difficulty is the want of foresight and foreknowledge in children: they are unable to realize consequences when the evil impulse is upon them. This, of course, decreases by time; and, according as the sense of consequences is strengthened, these become more adequate as a check to misconduct. It is then indifferent whether they are natural or ordained.

Among the natural consequences that are relied on as correctives of misbehavior in the family are such as these: going with shabby clothes, from having spoiled a new suit; getting no new toys to replace those that are destroyed. The case of one child having to make reparation to another for things destroyed is more an example of Bentham's "characteristical" punishment.

In school, the discipline of consequences comes in under the arrangements of the school for assigning each one's merit on an impersonal plan, the temper or disposition of the master being nowhere apparent. The regulations being fixed and understood, non-compliance punishes itself.—*Author's advance-sheets.*

What is maintained is that these other punishments are not so liable to abuse, nor so brutalizing to all concerned, as bodily inflictions.

EXPLOSIONS FROM COMBUSTIBLE DUST.[1]

By Professor L. W. PECK.

I WISH to demonstrate to you this evening, by a few simple experiments, the fact that all combustible material when finely divided, forming a dust or powder, will, under proper conditions, burn with explosive rapidity.

If a large log of wood were ignited it might burn a week before being entirely consumed; split it up into cord-wood, and pile it up loosely, and it would burn in a couple of hours; again, split it into kindling-wood, pile loosely as before, and perhaps it would burn in less than an hour; cut it up into shavings and allow a strong wind to throw them into the air, or in any way keep the chips comparatively well separated from each other, and it might be entirely consumed in two or three minutes; or, finally, grind it up into a fine dust or powder, blow it in such a manner that every particle is surrounded by air, and it would burn in less than a second.

Perhaps you have noticed that shavings and fine kindlings will sometimes ignite so quickly in a stove that the covers will be slightly raised, the door forced open, or perhaps small flames will shoot out through the front damper. You have, in such a case, an explosion on a very small scale similar to that of the Washburn, Diamond, and Humboldt Mills of this city, on the night of May 2d—upon which occasion the rapid burning of hundreds of tons of flour, bran, etc., completely demolished the solid-masonry walls, six feet thick, of the mills, and threw sheets of iron from the roof of the Washburn so high into the air that they were carried two miles by the wind before striking the ground.

Let us see now why such explosions occur. Wood has in it a large amount of carbon, the material of which charcoal is composed, and the air is about one-fifth oxygen. Now, at the ordinary temperature, the carbon of the wood and the oxygen of the air do not combine; but, when they are heated, as by friction, concentration of the sun's rays, chemical action as from a match, or in any other way, they combine to form carbonic-acid gas. This chemical action produces a large additional amount of heat which keeps up the action as long as there is any carbon and oxygen left to unite, and also makes the temperature of the gas which is formed very high.

As the space occupied by the carbonic-acid gas and that occupied by the oxygen which entered into the combination is the same at the same temperature, there would be no bursting if, after combination, the

[1] Lecture delivered June 1, 1878, at Association Hall, Minneapolis, Minnesota, at the request of the millers of the city.

temperature were the same as before; but it is a fact, which you have all observed, that fuel in burning produces heat; it is also a fact that heat expands a gas, and it is this great amount of heat, taken up by the carbonic acid formed, that produces the immense pressure in all directions.

Let us return to our log of wood. There is exactly the same amount of heat and carbonic acid produced when complete combustion takes place in each of the cases of burning, the only difference being as to time. In the first case, the explosion or pushing aside of the surrounding air occupies a week, in the last only a second.

Snow-flakes fall gently upon your shoulders, and you are required to perform an insensible amount of work to resist the crushing effect of each flake; but, suppose that all the snow that has fallen upon your head and shoulders for the last ten years was welded together in one solid mass of ice, weighing perhaps one hundred pounds, and that it should descend with the velocity of a snow-flake upon you, an immense effort would be required to prevent its crushing you, even if you were able to withstand the shock at all. The work of many days would be concentrated into an instant.

So it is with burning wood: four or five cords of wood, and a large stove, will give you a roaring fire all winter; the work done is manifested by the heat obtained, by the rushing of hot gases up the chimney, and of air from outside into the room through every crack. But, if the wood were ground into a powder and scattered through all the house, and burned instantly, the cracks, doors, windows, and flues, would not be sufficient to give vent to the hot gas, and the roof and sides of the house would be blown to pieces.

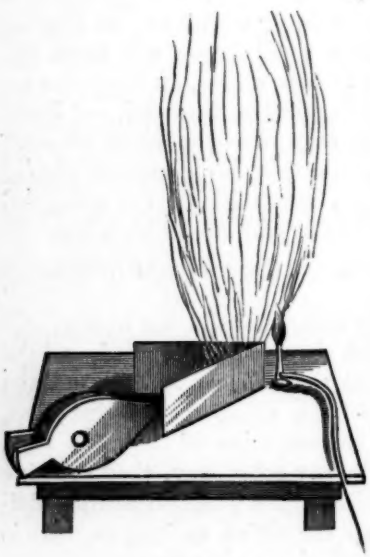

FIG. 1.

What is true of wood is also true of grains; also of vegetables, with their products when they contain carbon, with this exception: grain, either whole or ground, will not burn readily when in bulk. A fire could be built upon a binful of flour, and kept burning for half a day without igniting the flour; it would char upon the surface, but it lies in such a compact mass that the air does not get access to it readily, hence it does not burn.

I wish to show you now how combustible dust will burn when blown into the air by means of a pair of ordinary hand-bellows.

I have here two boards, about twelve by eighteen inches, nailed together, forming a V (*see* Fig. 1). Just outside of the V an ordinary Bunsen's gas-burner is placed, and within is a small handful of dust taken from a sash-and-blind factory. Upon blowing it smartly with the bellows a cloud is formed about fifteen feet high—extending, in fact, to the ceiling—which ignites from the lamp and produces a flash, very quick and exceedingly *hot*, resembling very much a gunpowder-flash. You will notice that a large amount of dust falls from all around the edge of the flame without burning; that is because it is not thick enough. Two things are necessary: first, that each grain of dust be surrounded with air, so that it can get the oxygen required *instantly;* and, secondly, that each grain shall be so near its neighbor that the flame will bridge over the space and pass the fire from particle to particle.

I think, after seeing the immense flame produced by such a small amount of fine saw and sand-paper dust, you will no longer wonder at the rapid spread of flames in furniture and similar factories. You know it is practically impossible to put out a fire after any headway is attained in these establishments; the draught produced will blow all the dust from walls and rafters into the air, and the building in an instant is a mass of flame. Perhaps many of you remember the fire in the East-Side Saw-Mills, a few years ago. Large masses of fine sawdust had probably collected upon the rafters, and the whole roof was perhaps filled with cobwebs loaded down with dust. A fire started from one of the torches used and shot through the mills with lightning-like rapidity, and, save for the fact that the ends and sides of the building were all open, there would have followed an explosion like that at the flour-mills. As it was, the men had very great difficulty in escaping with their lives, notwithstanding that a short run in any direction would have taken them out of the mill.

It is very evident that too great care cannot be taken to keep all such factories and mills as free from dust as possible.

I will now blow some ordinary starch into the air in the same way, and you notice the flame is more vivid than in the last experiment, and, if you were in my position, you would notice that the heat produced is much greater. Notice now that this powdered sugar burns in the same way.

You will see from the experiments further on that three-quarters of an ounce of starch will throw a box, weighing six pounds, easily twenty feet into the air, and that half an ounce, burned in a box, will throw up the cover three inches with a heavy man standing upon it.

With these facts, which I have demonstrated before you, no one need regard as a mystery the Barclay Street explosion in New York city, where a candy-manufactory, in which large amounts of starch and sugar might in many ways be thrown into the air by minor disturbances, took fire and completely wrecked a building and destroyed many lives.

I will now burn in the same way some buckwheat, which, as you will observe, gives a very large blaze; now some corn-meal, which is too coarse to burn as well; now some rye-flour, which burns much bet-

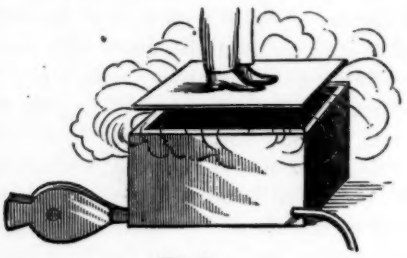

FIG. 2.

ter than the corn; now some oatmeal, the finer part of which only burns; and so I might continue with all sorts of finely-ground vegetable material.

Let us take up now the products of the manufacture of flour from wheat. There were between three and four hundred tons of these materials, upon which I am now to experiment, in the Washburn Mill at the time of explosion, and there was a corresponding amount in the Diamond and Humboldt Mills, which, by their sudden burning, produced the second and third shocks heard directly following the explosion of the larger mill.

The wheat is first placed in a machine where it is rattled violently and brushed. At the same time a strong draught of air passes through it, taking up all the fine dust, straw, etc., and conveying it through a spout to a room known as the wheat-dust room, or perhaps more commonly it is blown directly out of the mill.

You see some of this material here; it looks like the wood-dust of the first experiment, and, as you see, burns with a quick and sudden flash when subjected to the same conditions.

Here, then, we have the first source of danger in a flour-mill. A thick cloud of this dust, when conveyed through a spout by air, will burn in an instant if it takes fire; and, if there is any considerable amount of dust, as there would be if there were a dust-room, an explosion will follow which may become general if it stirs up a thick dust-cloud throughout the mill.

The wheat after it has been cleaned in this way goes to the crushers, which are plain or fluted iron or porcelain rollers, working like the rollers in a rolling-mill. The object of these rollers is, I believe, to break off the bran in as large pieces as possible, and to crush out or flatten the germ so that it can be separated with the bran from the rest of the meal.

The crushed wheat goes now to the stones, where so much heat is produced (average 135° Fahr.) that a large amount of steam is formed

from the moisture in the materials. This steam would condense in the meal and interfere with bolting, etc., if it were not removed. To effect this another draught of air and another spout are employed, and, as might be expected, this current takes a large quantity of the very finest flour, called flour-dust, with it. To save this a room is provided near the end of the spout, called the flour-dust house. The spout conveying steam and dust enters this room on one side, and another spout opposite leaves it, passing to the open air. It is in this comparatively dead-air space that the dust settles, and can be collected from the floor. Here is some of this material, which, as you see, when blown into the air, produces a vivid flash, extending from the table to the wall.

The evidence taken before the coroner's jury shows very clearly that it was this material that started the great explosion of May 2d. Just how the mill took fire will probably never be known of course, but in all probability the stones either ran dry—that is, were without any meal between them—or some foreign substance, such as a nail, was in the feed, producing a train of sparks such as is produced by an emery-wheel, or a scissors-grinder's wheel. These sparks set fire to small wads of very hot dust, which, as soon as they were fanned into a blaze, communicated it to the spout and house full of dust. An eye-witness of the explosion first saw fire issuing from the corner of the mill where this flour-dust spout was situated, the end of the spout having probably been blown out. This fire was followed instantly by a quick flash, seen through all the windows of the floor upon which the flour-dust houses were situated, followed instantly by a flash in the second story, then the third, and, in rapid succession, fourth, fifth, and sixth stories; then followed the great report produced when the immense stone walls were thrown out in all four directions, and the roof and part of the interior of the mill shot into the air like a rocket.

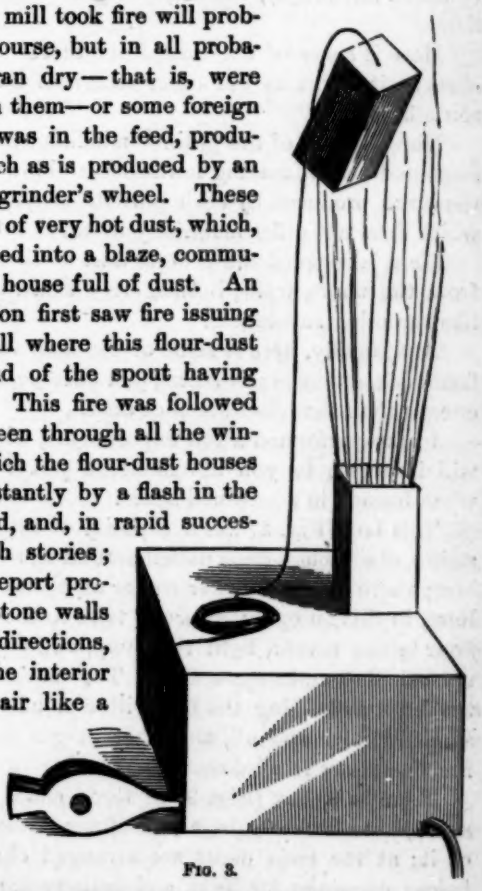

FIG. 3.

It would seem that a blaze is necessary to ignite the mixture, for I have tried powerful electric sparks from a machine, and from a battery of Leyden-jars; also incandescent platinum wire in a galvanic circuit, and glowing charcoal, without producing any fire, however thick the dust might be. Perhaps, however, under

more favorable conditions the dust would ignite directly from sparks, but it seems very improbable.

Let us continue now with the process through which the ground wheat is made to pass. From the stones it is conveyed to the bolting-reels, where the very finest is sifted out first, and we obtain a grade of flour; after the finer material is sifted out it goes to a coarser bolt, where the "middlings," as it is called, passes through, leaving the bran which comes out at the end of the reel. The middlings, as it comes from the bolts, has fine bran and dust in it, and, to purify it, it is subjected to an operation similar to that of cleaning the wheat, that is, in the middlings purifiers it is subjected to a draught of air which takes away all the light bran and dust, leaving the heavier material (purified middlings), which goes again to the stones to be ground into flour.

Here is some of the dust from these "middlings-machines;" you observe it burns as the other materials burned, quickly, and with intense heat.

Here is some of the purified middlings; each grain is comparatively large and heavy, making it difficult to blow it well into the air, but, as the blaze produced by each particle is quite large, a flash is produced which does not differ materially from the others.

Here is some of the general dust of the mill, that is, dust swept up from the floors, walls, beams, etc. You will see it acts in all respects like the other substances.

And, finally, here is some of the flour taken this afternoon from the flour-sack at home; it burns, you observe, if possible with even more energy than the other kinds of dust.

I have performed a few experiments, which I will now repeat, which will illustrate to you the immense power that these materials exert when burned in a confined space.

This box (Fig. 2) has a capacity of two cubic feet; the cover has a strip three inches deep nailed around it, so that it telescopes into the box; there is in this lower corner an opening for the nozzle of the bellows, in this an opening for the tube to the lamp. I place now a little flour in the corner, light the lamp, and my assistant places the cover upon the box and steps upon it. Take notice that upon blowing through the hole, and filling the box with a cloud of flour, the cover comes up suddenly, man and all, until the hot gas gets a vent, and a stream of fire shoots out in all directions.

Here is a box (Fig. 3) of three cubic feet capacity, including this spout, nine inches square and fifteen inches long, coming from the top of it; at the ends doors are arranged closed like steam-boiler manholes; openings for light and bellows are arranged as in the previous box.

Here is a box, weighing six pounds, that will just slip over the spout; it has a rope lest it should strike the wall after the explosion.

Placing now the lamp in the box, some dust in the corner, and the box over the spout, we are ready for another explosion. You observe, after blowing vigorously for a second or two, the dust in the box takes fire; the box over the spout is shot off, and rises until the rope (about twelve feet long) jerks it back; it strikes the stage with great force, rebounds and clears the foot-lights, and would strike the floor below were it not for the rope.

I have thrown a box similar to this in the open air twenty feet high, while, as we shall see presently, less than an ounce of flour is being consumed.

I have fastened over the top of the spout five thicknesses of newspaper; upon igniting a boxful of dust as before, the paper is thrown violently into the air, accompanied by a loud report as it bursts.

For the last experiment I have a box of four cubic feet capacity (Fig. 4); five sides are one and a half inch thick, the remaining side one-quarter inch. Upon igniting the dust in this box, filled as in the other cases, the quarter-inch side bursts, and a stream of fire shoots out half-way across the stage.

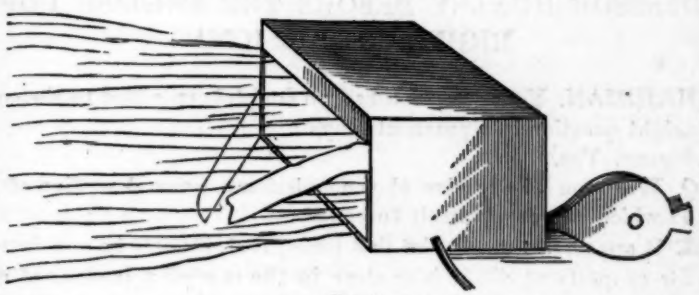

Fig. 4.

One pound of carbon and two and two-thirds pounds of oxygen, when they combine to produce carbonic acid, will evolve heat enough, if it were applied through a perfect heat-engine, to raise 562 tons ten feet high; if, therefore, forty per cent. of flour is carbon, it would require two and a half pounds to accomplish this result, if an engine from which there would be absolutely no radiation, conduction, or loss of heat, in any way, were a practical possibility. Let us see how much air would be required to supply oxygen enough. Under ordinary conditions every 100 cubic inches of air contains 7.13 grains of oxygen, from which we find that 151½ cubic feet of air would be required for the 2⅔ pounds of oxygen. Hence the 2½ pounds of flour must be equally distributed as a dust through 151½ cubic feet of air, in order to produce the most powerful result.

If 41 ounces of flour requires 151 cubic feet of air for perfect combustion, one cubic foot of air will supply oxygen enough for $\frac{41}{151}$ of an ounce of flour. Hence our box, which lifts the man so readily, burns

one-half ounce of flour or less; and the other, which throws the box into the air, three-quarters of an ounce, unless, as I think quite probable, an additional amount of air is drawn in through the cracks as soon as the vent is opened at the top of the box. In fact, these experiments work better if a few small holes are made near the bottom of the boxes.

It may be worthy of mention here, as a point of interest to insurance companies that, in all dust-explosions, a fire precedes the explosion in every case. The dust must burn before the heat that produces the immense expansive force is generated.

Too great precaution cannot be taken in all kinds of manufactories, where combustible dust is produced, against fire, especially in those establishments where it is conveyed in thick clouds by air-draughts through spouts and rooms.

PROFESSOR HUXLEY BEFORE THE ENGLISH COPYRIGHT COMMISSION.[1]

CHAIRMAN. Your attention has, no doubt, been called to the copyright question in a practical shape?

Answer. Yes.

Q. Will you kindly give the commission a general outline of the way in which it presents itself to you?

A. It appears to me, in the first place, that, if there be any foundation for property at all, it is as clear in the case of a book as of anything else, a book being the investment of a man's capacity and knowledge, and requiring the sacrifice of a vast amount of his time. Under those circumstances it appears to me that *prima facie* it has the same right to be protected as any other kind of property. But then, of course, a practical difficulty arises from the fact that a book can be readily copied, and that under those circumstances what evidently amounts to stealing the property of the author cannot very well be brought under the ordinary conditions of theft. I should, however, be glad in the first place to express my belief that, so far as a matter of right is concerned, if there be any foundation for rights of property, the right of an author in a book is as complete, and extends as far, as the right of any person to any property whatever. I think that my view upon the subject will be clear if I take the concrete case of a man who has written a book and who has a certain number of printed

[1] Friday, April 13, 1877: Lord John Manners, M. P., in the chair. Members of the commission present, Sir Henry T. Holland, Sir John Rose, Sir H. Drummond Wolff, Edward Jenkins, Esq., M. P., Dr. William Smith, James Anthony Froude, Esq., Anthony Trollope, Esq.

copies of it in his printer's or publisher's hands. I presume that there is no doubt whatever that those copies are his property in the strictest sense of the word, and that the law will protect him against any person who proposes to rob him of that property. I have recently met with the argument (and, singularly enough, professing to proceed from the straitest school of free-traders), that the state, or the Legislature acting for it, should, as I understand the argument, regard books as a kind of property to be disposed of mainly for the benefit of the persons who read them, and that the state should take upon itself somewhat the same function as it used formerly to do when it passed sumptuary laws, and should regulate the amount of profit to be derived by the author according to what it considers fair and reasonable. That strikes me as being a reversal of all rules of commercial policy at present recognized. But supposing it to be admitted that that is a right and just thing to do, I do not see why you should not go a step further. If, for example, I had had the good fortune to write such a work as "Hamlet" or the "Principia," it would appear, according to that line of argument, that the state would be justified in seizing all the copies of it, and in disposing of them in such a manner as might be conducive to their distribution, and that mainly on the ground of the great service to the public which those books might render. I do not know whether any one has carried the argument so far as that, but it appears to me to be the legitimate outcome of it. However, an author who has an edition in his publisher's hands has a right, at present, to regard it as his absolute property, to deal with as he pleases, and he has a further right as vender to make any contract which he pleases with any person who proposes to be a purchaser of one of the copies of that book; that is to say, if he chooses to make it a condition of sale that the purchaser shall not copy or multiply by printing the work which the vender sells under certain penalties, I apprehend that the existing law will enable him to recover those penalties from any person who violates that contract. The property being his own, he has a right to make any conditions he pleases with regard to the disposal of it; the person who buys buys on those conditions, and is subject to them. That appears to me to be the natural mode of looking at the trade in books as a branch of commerce which is subject to the ordinary rules of free trade, namely, that a man shall make any contract which he pleases with regard to the disposal of his property. And I look upon the copyright law simply as a means of overcoming the inconvenience which would arise out of that state of things; it would be a very cumbrous process; it would largely interfere with the sale of books, and it would doubtless be very hard to recover the penalties in the case of a breach of contract. So far from copyright law being any favor which the state confers upon the author, any privilege which is granted to him by the state, it seems to me that it is simply a mode of preventing such inconvenience as I have just referred to; so that in my

apprehension the application of the word "monopoly" to persons who possess rights under the copyright law is an entire mistake; it is merely a contrivance, arising out of the peculiar nature of book property, to put that property upon the same footing as other kinds of property. I think that that is all I have to say upon the general part of the question.

Q. Are we to understand it to be your contention that, under the old common law of the country, there would have been a right in the author to sell or not to sell his book in any way he pleased, and that for the convenience of the public the statute law has intervened, and, by what is commonly called the law of copyright, has attached certain conditions, and even restrictions, to that common-law right, for the benefit of the author on the one hand and of the public on the other; is that generally your view?

A. I would not suggest for a moment that that is the actual historical origin of copyright law, but I think that that is the way in which it ought to be regarded as a matter of equity.

MR. TROLLOPE. Those who have given evidence before us rather in opposition to than in support of the present law of copyright have sometimes done so on the plea that the law at present is favorable rather to booksellers than to authors, and they have based that plea on an idea that authors, as a rule, dispose of their copyrights to publishers, so that the property becomes not the property of the man who has worked with his brain, but merely of a speculator. As far as you are aware, do you think that authors do dispose of their copyrights entirely?

A. I cannot say. I certainly do not do so myself, and I do not think that I know among the men of science anybody who does; but it appears to me that, supposing such to be the case, it applies to all sorts of property, and to the relations of needy men to middle-men of all kinds.

Q. The second part of your answer is perhaps a sufficient answer to the next question which I was going to ask you. As far as you are aware it is not so; but, even if it were so, you do not think that that would be any argument against the present law of copyright?

A. No; I take it that that must inevitably happen wherever men want money, and there are persons who are willing to buy their property.

Q. It has been suggested to us, though I can hardly say that it has been absolutely recommended, that, in lieu of the present modes of disposing of literary property, an author should have a right to a continued royalty; that is to say, that any publisher should be enabled to bring out an author's work, paying him some proportion of the price, which should be fixed not at all by the author, but by the law. Do you imagine that such a scheme as that could work?

A. No. Who is to be the judge as to what is the value of the author's work but himself? Who is there in the Government who is

competent to form the slightest conception about it? What suggests itself to me is that the matter should be left to the ordinary operations of supply and demand. Why am I to be debarred from making any bargain I please with regard to a piece of literary property, otherwise than with regard to any other property?

Q. Does not it occur to you that no fixed percentage, let it range as it might, from five up to fifty per cent., could be fairly applicable to all classes of books?

A. Am I to understand that the proposition is to make one fixed percentage for all classes of books?

Q. As far as we have understood the proposition that is the proposition which has been made.

A. I can hardly conceive that that has been made as a serious proposition by anybody who knows anything about the writing of books; it is simply astonishing.

Q. You are aware of the present term of copyright?

A. Yes.

Q. You are aware that the copyright for your works will probably not come to an end all at the same period, unless it should happen that you should live for a very long time after the completion of the last; for instance, that if you were to die say within the next fifteen, twenty, or thirty years, the copyright of your works would come to a close at various periods, the law being that each should have whichever was longest, forty-two years or seven years after life; and you may probably be aware, to take the instance of one author, that the earliest of Mr. Dickens's copyrights are running out, I believe, in this year, and that the latter of them will run on to, I think, the year 1912. Does it not occur to you that it would be desirable that property of this kind should come to its conclusion all at one and the same time?

A. Your question rather involves an opinion upon the propriety of terminating the copyright at all, and I am by no means satisfied that there is any ground for terminating a man's right to his property in books rather than in anything else.

Q. You are probably aware that the French term is fifty years after death, and the German thirty years after death?

A. Yes.

Q. And that therefore in Germany or in France the copyrights of an author will come to their conclusion at the same time?

A. Yes.

Q. I will ask you whether you do not think that that mode is a better mode than the one which we have adopted. Putting aside the question whether an author's copyright should be perpetual, and assuming that the law will enact as it has enacted, that there shall be a term, would it not appear to you that a term similar to the French or the German term would be better than ours?

A. I think so, if you are to have a limit.

Q. You will no doubt perceive, with regard to your own works, that under the present system a time will come when your executors, or those who come after you, will be debarred from protection in the publication of all your works, although they will be protected in the publication of a part?

A. Certainly.

Q. Does not that appear to you to be inconvenient?

A. I think so, very.

MR. JENKINS. You say that you think that a book, being the investment of a man's capacity and knowledge and time, is as much his property as any other property, and that the right of an author extends as far as the right of any person to any property whatever. I only want to ask you to point out what, of course, must have occurred to you, that there is a distinction between a book which conveys ideas and a machine which embodies them in a form which cannot be carried away or altered; and I would ask, considering the fact that supposing you write a book, another man, without stealing your book can steal all your ideas, and adapt and use them, whether there is not, therefore, a distinction between the property in a book and the property in any other thing?

A. No; I do not think that the property in a man's book consists in the ideas. I should limit his property entirely to the particular form in which he chooses to clothe those ideas. If you come to look into the matter carefully, it would be very hard to say how far the ideas contained in a man's book are his own; he owes them very largely to his ancestors and his surroundings, and to other people, and I do not think that it is at all clear that you would be justified in laying an embargo upon a particular set of ideas because they happened to be contained in a particular book. My contention for the protection of property in books is entirely with regard to the particular form in which the author chooses to put his ideas.

Q. Supposing that, instead of writing a book, a man gives a series of lectures, for instance, as you do—fortunately for England—and that those lectures are reported, or that persons carry away in their memory the words and the essence of them, you admit that then, a man having chosen to disperse them to the world, neither on principle nor upon the grounds of expediency ought it to be held that those lectures are to be reserved for the man himself?

A. Certainly not the ideas or the facts; but I take it that a man has no right to publish a report of what he shall call my lecture; that is quite another thing: then he asserts that the form is mine as well as the substance. If he chooses to appropriate my ideas and himself publish them in any other form, and say, "This is what I think," I do not think that he should be prevented from doing so, and in my opinion he has a right to do it; but it is quite another matter if he calls anything which he chooses to publish my lecture.

Q. Take the case of Fichte: when he was twelve years of age, if he heard a sermon or an address he could go away and repeat it verbally; you cannot prevent that?

A. Certainly not.

Q. He carries away the ideas, and carries away the whole thing: is he to be prevented from transferring it to anybody else?

A. He is to be prevented from putting it in the shape of a book, and selling it to the disadvantage of the person who has given the lecture or the sermon.

Q. Are you laying down a question of abstract principle, or is it merely one of expediency?

A. With regard to that particular case of lectures, it is a point on which I hold a very strong opinion indeed. I have seen the opinion advanced that a man who has given a lecture has given it to the world, in the same way that a man who has written or published a book has given it to the world, and that on the ground of his having given it to the world he cannot call it back again. I must confess that that strikes me as the strangest confusion between publication and donation. If I announce myself as ready to give a lecture to-morrow, to which persons may be admitted at a certain fee, I make a contract with the persons who come that, in consideration of their paying so much, they shall hear me speak for an hour, and that is all; I do not sell my right to print it and sell the lecture, and especially not my right to call it mine; the contract is a perfectly clear one. Take the case that I open a gallery of photographs, and that I say that people shall be admitted on paying a shilling each: I do not give to every person who comes there the right to copy my photographs and sell those copies himself; we see at once that that would be a preposterous supposition; and in the same way a person, who is admitted to my lecture on the understanding that he is to get his money's worth (if it be his money's worth, I do not say that it will be) in hearing me speak for an hour, does not thereby obtain the privilege of making a profit by printing it and calling it my lecture.

Q. But you admit that, even if you give a lecture to a limited audience, your ideas are thereby distributed?

A. I do not ask for any protection to ideas; it is the form of the thing which is mine.

Q. It is simply the matter of the form in which you embody your ideas, and it is for that that you claim protection?

A. Certainly.

Q. Is there not a very great distinction between the form literary and the form artistic or mechanical?

A. I really do not see where the distinction lies.

Q. Supposing that I have invented a machine, if I write an account of it to the *Contemporary Review* or the *Fortnightly*, or to any mechanical magazine, and it is published, after that I cannot get a patent for it?

A. No.

Q. Why, therefore, should you who have given a lecture, or have even written a lecture, if you choose to make it known in any way to other persons, have a right still to get a copyright for it?

A. The assumption in that argument, I think, is that the patent law is just; to that I venture to demur, in which case I need not follow out the parallel.

Q. I am advisedly not putting a question about the justice of it?

A. It is obvious that, if I do not admit the justice of a regulation in virtue of which a man who has published a design for a machine cannot obtain a patent for it, the rest of the argument does not affect me.

Q. Then you would put them all on the same footing?

A. Certainly.

Q. So that, really, to support the whole of your argument, you would be obliged to fall back upon this: that a man has a copyright in his ideas?

A. No; in the form into which he puts them. For example, in the case which you were suggesting to me just now, a man who makes a machine not only has an idea about his machine, but he embodies it in a particular form, with a certain application; and I think that is one of the great defects of the present patent law, that it has given protection to the idea in applications of which the original inventor never dreamed. I should restrict all protection of that kind to the precise result of a man's intellectual activity, that which is specially his own.

Q. Before we had a copyright law it was held, as you are probably aware, that if a man had embodied his ideas in the shape of a manuscript, that manuscript before he had handed it to a printer was his property, not merely the paper and the writing, but also all that was in it, that is to say, the form in which it was embodied, and that he could sell it to a publisher; but now there is an alteration in that: before a man hands his manuscript to a publisher he has a right to the ideas and to the form, but, after he has handed it to a publisher, and it is published, then in virtue of the statute law he becomes entitled to a property in what you very properly call the form of the book. The result, after all, is that it has simply been adopted as a matter of expediency and of public policy that there should be conferred upon men who write books a certain right of obtaining a profit from them during a certain time. If your contention were correct with regard to the theory of a property in books and ideas, ought not the property to be a lasting one without any definite period?

A. Certainly; I have not a doubt of it.

Q. Then you would urge upon this commission that, when a man had put his ideas into the form of a book, the copyright in that book ought to exist forever?

A. I think that, as a matter of strict right, it should be so, but as a matter of expediency I do not think it is worth while asking for it; I

think that a couple of generations would probably be as much as in practice is really needed; but, if you ask me what I think is his abstract right, I should certainly say that the man should have the property in perpetuity, and be able to hand it down to his children like any other property.

Q. Then on what theory is our present copyright law framed, if that is your opinion?

A. I would rather decline to have to justify the existing copyright law at all; I am not concerned in doing so; I think that it is not easily justifiable.

Q. That brings us to a practical question: how would you practically embody in legislation your idea of the principles of a just copyright law.

A. That would really be a matter requiring very grave consideration.

Q. Let us take it in stages. First of all, at all events, you would insist upon the absolute right of the author to a property in his book?

A. Yes.

Q. In perpetuity?

A. I do not insist upon perpetuity.

Q. I mean simply for the moment, abstractedly?

A. For the present.

Q. Then you would recognize that there might be reasons of public policy why it should not be granted in perpetuity?

A. I would rather say that it is not worth while practically to attempt to get a thing which it is hardly likely you will be able to get under the present state of the public feeling. If we had to begin *de novo*, I should certainly insist upon the perpetuity of the property, but at present I think that it would be impracticable and hardly worth while.

Q. Still, going upon your principle that, abstractedly, the author ought to have it in perpetuity, of course it would only be a reservation on the ground of public policy, or something of that sort, which would justify a limitation?

A. I think that there is another justification, namely, that it is not worth while in real life to attempt to get things which it is impossible to get.

Q. We are really looking at the matter for the moment from different standing-points: I am not asking you to consider it from the point of view of an author who is willing to take what he can get; I am asking you, if you will do so for the moment, to look at it simply from the point of view of a statesman who is considering what ought to be the principles of the law. First of all you lay down a very wide and general principle, namely, that an author is entitled to the ideas which he embodies in a book as much as any other person who owns property, whether it is a table or an acre of land, is entitled to it?

A. Pardon me, I have been very careful to say that I think that an author has a right to the form in which he embodies his ideas.

Q. That is what I said; I supposed him to embody his ideas in a book. Then you will admit that, if there is a copyright law which limits that right, the only justification for that limitation would be public policy, or public convenience, or something of that sort. Let us take it from that point of view: how can you reconcile that view of the principle of a copyright law with the existing law?

A. I do not reconcile it; I ventured to say just now that I think that the present law is bad in principle.

Q. Then you admit that the present law is not based on your principle?

A. Certainly not.

SIR H. D. WOLFF. Have you thought upon the subject whether it would not be for the advantage of authors that the copyright should be extended for a period longer than exists at present; that it should even be made the perpetual property of the family of the author?

A. My impression is, that it would be for the advantage of the author if copyright were made perpetual.

Q. You said just now that the legislation had not given any privilege to the author by giving him copyright; surely it gives him a protection to his property which would not otherwise exist; do you not think so?

A. Quite so. But I ventured to say that that was not a boon but simply a piece of justice, and that he ought to have the protection.

Q. But do you not think that the Legislature would not give the protection unless it was for the benefit of the public that authors should be encouraged?

A. Assuming that it is advantageous that they should be encouraged, a certain benefit is given to the public.

Q. The copyright is given to the author that he should be free to publish his works?

A. I look upon a book in the same way as I look upon any other kind of property. There are people who discuss the expediency of the protection of any property at all; but it appears to me that upon every ground upon which it is expedient to protect any sort of property it is expedient to protect book property.

Q. I am not at all disputing that, but I wish to arrive at this view, that you give this protection to the author to enable him to have property in what is a peculiar property; there must be a peculiar protection given to a property of peculiar nature, and, having once given him that protection, do you not think that the book itself, or the chattel which he produces, should then go into the ordinary rules of supply and demand; that is to say, that when you have done that, and have reserved to him his property in his book, the public ought to be able to obtain

that book, so long as his rights are guarded, at the cheapest possible rate?

A. I do not see why the public has a right to demand it in the case of books more than in the case of beef, or mutton, or potatoes.

Q. Except that in the supply of beef and mutton and potatoes there is a regular competition?

A. Certainly.

Q. Whereas, there is no competition in books. If you cannot get beef you will get mutton. Whereas, if you cannot get Macaulay's "History" you will get nothing else which represents Macaulay's "History." You want that particular book?

A. But you might say that you want six-year old mutton, and that you cannot be content with anything else.

Q. We do not negotiate with foreign countries to obtain a copyright for six-year old mutton. The object of this commission is not only to improve the laws of copyright in England, but to see whether we cannot extend the rights of English authors to other countries?

A. That is a totally distinct question.

Q. We are the public practically who negotiate for you. If we do that, do you not think that we are entitled to some compensation for the trouble which we have in obtaining all these privileges for you?

A. I am not at all clear about that. I think that, in these matters, the state should have regard to public justice and public morality, without looking for any particular reward from the persons who are served.

Q. But by the present system of copyright, according to the ideas of some people, it does not merely secure the property for the author, who is clearly entitled to every advantage which the law can give him, but it enables the sale of books to be conducted on principles which are not acknowledged in any other branch of trade. For instance, it enables a bookseller or publisher to keep up books at an unnatural price for his own advantage, and, as is thought by some people, very often to the disadvantage of the author.

A. That I cannot comprehend, because in all my own dealings with publishers I have made my own terms, and, if the terms of the publisher do not suit me, I do not publish with that particular publisher.

Q. That I can understand; you make your own terms, no doubt, but some people think that, if instead of the present system of publishing books at a dear rate, and putting them through the circulating libraries at a high rate, any means were devised by which authors could go direct to the public, a larger sale of a cheaper edition of their books would give them greater popularity, as well as more money, than the present restricted system through the circulating libraries?

A. I think that it is a very dangerous thing to suppose that you can regulate matters of that kind by legislation.

Q. But supposing that we obtain copyright for you in America, where

the sale of your books is stated to be enormous, it gives you protection, and a greater remuneration for your books in America; would it not be unfair in that case that we, having done this for you, should as the British public be exposed to having a dear edition of your books here, and a cheap edition in America?

A. I would much rather that you did not interfere with us at all. I am now speaking of you as legislators. I would rather that you should not afford especial protection, but should consider books as property like any other property, and not meddle with us in future.

Q. We cannot take that course, because foreigners do interfere with you.

A. And in my opinion they will continue to interfere. I know something about the United States, and their mode of doing business in books in that country, and my own belief is that the expectation that the Americans will ever listen to any proposal of English copyright is chimerical; their system of doing business is quite opposed to it. I do not think that this prospective boon which you offer us is likely to have any great value.

Q. As a matter of author's *amour propre*, would it not be far more satisfactory to you if your books were possessed by a very great many households in this country rather than being hired from a circulating library?

A. I do not care much about it; if I have half a dozen careful readers, I would rather have them than all the rest of the world put together.

Q. If you got more pay than you do now from having your books sold at a cheaper rate, you would be satisfied with that?

A. I should like to get the more pay in my own fashion, and to deal with it like any other business. I do not want anybody else to help me to get more pay; if you let me deal with my own property in my own fashion, I am quite happy, and I do not thank anybody who interferes.

SIR H. HOLLAND. From your knowledge of American dealing, do you think it at all probable that the Americans would be inclined to make a convention upon the understanding that the book for which copyright is granted is to be published and printed in America?

A. I have never heard that question discussed.

CHAIRMAN. Several questions have been asked upon the general aspect of copyright. Coming more to the details of the question, might I ask you what in your opinion would be the effect of the abrogation of or a considerable diminution in the terms of copyright upon works the production of which requires time and research, and perhaps costly illustrations?

A. My impression is, that it would be altogether fatal to the production of works of that kind. I think it will be obvious that such must be the case; and I can speak the more strongly here, because works of that kind are those with which I am familiar. I will take the

case of any one who has been preparing a work, let us say upon comparative anatomy, which has probably occupied him for a great many years. He has himself had to make a great number of laborious dissections and to have them drawn, and he or his publisher has had to invest a great deal of money in illustrations. He brings out his book. That book, if it is well done, will preserve its value for a century. At the present moment Cuvier's "Ossemens Fossiles," which I think has been published for about half a century, is in many respects as valuable a book as ever it was, and is as often consulted as ever it was. If, when such a book as that is published, or within a short time after it is published, anybody has a right to republish it, the practical effect is that the text will be copied, at probably a thousandth part of the expenditure and time required for its original production, then the illustrations will be copied; and the natural result will be that the reproduction of the book will be sold at a price far less than that at which the original book was sold, the consequence of which is that the author and the publisher of the latter alike have their interests ruined; and the practical result would be that no publisher would take such a book; in fact, he could not do it, he would be liable at any moment to be undersold. That is true of the whole class of botanical works, zoölogical works, anatomical works, and the great mass of illustrated works having relation to physical science.

Q. Carrying on the thought which you have expressed, what, in your opinion, would be the practical result upon all this important class of works which you have described of either abrogating or materially diminishing the term of copyright so far as the public is concerned?

A. I think that it would simply stop their production, and that exactly in proportion to their value and usefulness. The more such works were sought after, and the better they were, and the more largely they were in demand, and suited themselves to the wants of the time, the more certainly would they be pirated, and I do not see how anybody could afford to produce them.

Q. Might it not be that some publisher in a very large way of business might find that he could impose his own terms both on the author and the public?

A. I quite think that that is the inevitable tendency of the abolition or a great diminution of the term of copyright; and I would justify that belief by what happens at the present time in the United States; I myself am paid upon books which are published there; my American publisher remits me a certain percentage upon the selling price of the books there, and that without any copyright which can protect him; but then I am informed that the practice of all the great houses in America (there are some three or four large publishing-houses with very great capital), if anybody publishes one of their books, is to publish a largely cheaper edition at any cost, and they would make any pecuniary sacrifice rather than not cut out a rival. The great houses

understand that, and the consequence is that they do not play that game with one another; but, practically, English authors at the present time stand in the same relation to the American publishers that they would to the English publishers if copyright were abolished; and whether I get any money or not from America for my works is entirely dependent upon the strength of my American publisher. If he were not a man who would not stand being trifled with, and if it were not known that he was so, he could not afford to pay me anything.

Q. Therefore, in your opinion, the effect of the contemplated change would be not in the interest of the author, but in the interest of the publisher?

A. I think that neither the author nor the publisher would be served, and I think that the publisher's business would be made very precarious. He might doubtless sometimes reap large profits, but he would always be at the mercy of unscrupulous competition.

MR. TROLLOPE. Are you assured that this rule to which you allude among American publishing-houses always prevails?

A. I cannot say; I have been assured that it does largely prevail there.

Q. Then you would be surprised to hear if I told you that a large American publisher, who has been for many years in the habit of publishing my own books, and with whom I once remonstrated for doing so without consulting me, told me that he intended to continue to do so, but that he would not republish a certain work if it were published by any other American house before him?

A. Yes; that is a very curious fact. I know of no parallel cases.

Q. But if the case to which I have now alluded is a type of the way in which business is done in the United States, it would be subversive, so far, of the evidence which you have given, would it not?

A. Quite so; but my opinion is the exact contrary. I have been informed (I do not profess to have absolute proofs of it) on exceedingly good authority that a publisher who has published one or two of your books in the United States would think himself very hardly used if you allowed any other publisher to publish for you.

Q. I think that you will understand the point which was put in my question, which intended to convey the story of a transaction which had absolutely taken place?

A. Quite so; I quite understand that.

Q. I do not know that I need hesitate to say that the publisher was Mr. Harper, and you are aware that he is probably one of the largest publishers?

A. Yes.

Q. You also said, I think, just now incidentally, in answer to a question from Sir D. Wolff, that you were very strongly of opinion that American legislation would not give us the international copyright which we are seeking?

A. I think it exceedingly improbable. So far as I can gather the state of public opinion in America, their reply to all remonstrances is, "We want to have cheap books for our people, and we will not listen to anything which will interfere with our having cheap books for our people."

Q. You may probably be aware that a very large body of American publishers, not, I think, including the largest houses, but still including many large houses, have advocated international copyright?

A. Yes, I am aware of it.

Q. And you perhaps are aware that, although the list of those who have done so does not contain all the larger houses, it contains by far the greatest number of those with whom we are acquainted?

A. I have understood so. I was never myself quite clear how far the movement was in earnest.

Q. I think that the house with whom you are yourself concerned, that of Messrs. Appleton, agree to it, do they not?

A. I believe so.

Q. I will not mention other names, but can I have reason for supposing that they are not in earnest, considering that they have spent considerable sums of money in advocating their cause?

A. I will not venture to say that particular gentlemen who have advocated this cause are not in earnest; very possibly they are; but it does not appear to me to be compatible with the universal cry which one hears, or which is always raised, when this question is discussed, "We want cheap books for our people, and we will have them at all costs."

Q. Are you aware that the Senate in the United States at one time assented to a proposition for an international copyright?

A. I have heard so. It is a very curious thing that whenever negotiations of that kind arise they are carried on very successfully for a time, and very admirable speeches are made upon all sides, but they always come to nothing.

Q. In our own legislation at home has it not generally been the case that great changes have been ventilated for a considerable time and have failed, and failed, and failed, until at last they have been passed?

A. Yes; that I think has generally been where there has been a great popular cry in their favor. When I visited the United States the popular cry appeared to me to be just the other way; it was for getting cheap books at all costs. I should not like to give very decided opinions upon these matters, but that is what has struck me.

DR. SMITH. If I understood you aright in reference to illustrated works you said that the cost of the original drawing, and the drawing in wood, and the engraving, must be very large, and that there are processes, by means of photography and other means, by which they could be reproduced very cheaply?

A. Yes.

Q. And consequently that if the term of copyright was materially abridged, or if another publisher was allowed to reprint them by paying ten per cent. royalty, he could reprint those works at such a very much cheaper price than that of the original edition as to render it almost impossible for a person to obtain any profit from the original edition?

A. Not only by the mere process of copying, but it stands to reason that if anybody has provided woodcuts in an extensively illustrated work, even if those woodcuts are reëxecuted in wood by the best artists, it can be done at a far less cost for a copyist than for the original publisher, because the woodcut in the original book represents not merely the labor of the wood-cutter, but the labor of an artist who has been employed before the wood-cutter to make the drawing from which the wood-cutter makes his woodcut, and in all probability many hours' labor of the person who made the dissection, or whatever it was, which is there depicted.

CHAIRMAN. Some questions, I believe, were asked you with respect to copyright in lectures?

A. Yes.

Q. Are you aware of what the practical protection afforded to lectures by the present law is?

A. I have understood that it is a very curious protection, and that you have, I think, to give notice to a justice of the peace.

Q. To two justices of the peace?

A. I should like to speak very strongly upon that point, because I myself have had occasion to feel the ill effects of the present practice. I think that it is a most iniquitous thing that a man who is admitted to a lecture should be able to print it with your name to it, and circulate it through the country with all the faults and imperfections arising out of the mode of reporting, without asking your leave or without your being able to restrain him.

Q. Having expressed the grievance which you feel, are you prepared to give the commission any suggestion as to the mode of removing that grievance?

A. I think that the simple and obvious course is to give a man absolute property in his lecture.

Q. But unless the public were informed in some way that that absolute property was given, might there not be injustice on the other side?

A. I do not think so; I think that the light of Nature ought to tell a man that he has no business to report a lecture and sell it without the permission of the person who gave the lecture. It does not require a very keen moral sense to see that that cannot be considered quite a right proceeding.

Q. But there are reporters and reporters. If a public lecture were given on a very interesting subject, I presume that the reporters of the

daily press would attend; would you draw a distinction in that case between them and a reporter of another sort?

A. No; I should always make it the right of the speaker to admit reporters or not. Allow me to tell you what happened to myself. I am not complaining of it for a moment, because I knew exactly what was to be expected, and I did not care whether it happened or not; but permit me to state what happened to me in the United States the other day: I gave three lectures in New York, which had cost me a very considerable amount of trouble, and they were illustrated by diagrams, etc. I found that it was the intention of the proprietor of one of the leading papers there to send short-hand writers who would take down what I said *verbatim;* to send artists who would copy all the diagrams, and to print my lecture the next day in the paper in full, and not only so, but when the three lectures were completed to make them up into a sort of pamphlet and sell it, without consulting me in any way whatever. As I say, in this particular case I did not care in the least about this proceeding; and I have the less reason for complaint, as the proprietor of the paper subsequently offered me a certain share in the profits of the sale of the pamphlet; but, in principle, it appears to me to be sheer piracy.

Q. That, of course, would be under the law of the United States. Are you able to tell us what the United States law with respect to lectures is?

A. I cannot say, but the same thing might take place here if I had not given notice to two justices of the peace, or complied with whatever is the requisite formality, which is a thing I never did in my life. I fancy that in practice the same thing might be done here.

Q. If you gave a proper notice, you would have the law on your side?

A. Very few persons know of the existence of that law.

Q. Admitting the grievance to exist, as I think the commission would probably be prepared to do, in removing it might it not be well to substitute some more easy process than that of giving notice to two magistrates within five miles?

A. Certainly, one would think that there must be a great number of easier processes than that.

Q. It has been suggested by some witness that a notice put over the door, so that everybody should see it when he entered the room in which the lecture was given, that the lecture was copyright would be sufficient; would that meet your view?

A. Yes, or the same practice might be adopted as in the case of reserving the right of translation of a book; you might put on the ticket, "All rights reserved."

DR. SMITH. Supposing that the lecturer himself gave notice, at the beginning of the lecture, that he reserved to himself the right of printing it, might not that be sufficient?

A. There might be a difficulty in proving that; but if the ticket, in addition to the other matter which was on it, had printed upon it, "All rights reserved," or something of that sort, it would be a sufficient notice.

STRANGE ANIMAL-FRIENDSHIPS.

WHY married folk, so ill-mated as to agree only to differ, should be said to lead a cat-and-dog life, is not very clear, since those household pets, being intelligent, affectionate, cheerful, and sociable creatures, very frequently contrive to live harmoniously enough together. The Aston Hall cat, that ate, associated, and slept, with a huge blood-hound, only did what innumerable cats have done. Such companionships are too common to be reckoned among strange animal-friendships, such as that most singular instance of attachment between two animals of opposite natures and habits, related to Mr. Jesse by a person on whose veracity he could depend. The narrator boasted the proprietorship of an alligator which had become so tame that it would follow him up and down stairs; while it was so fond of his cat's society that, when she lay down before the fire, the alligator followed suit, made a pillow of puss, and went off to sleep; and when awake the reptile was only happy so long as puss was somewhere near, turning morose and ill-tempered whenever she left it to its own devices.

Many equine celebrities have delighted in feline companions, following in this the example of their notable ancestor, the Godolphin Arab, between whom and a black cat an intimate friendship existed for years, a friendship that came to a touching end; for, when that famous steed died, his old companion would not leave the body, and, when it had seen it put underground, crawled slowly away to a hay-loft, and, refusing to be comforted, pined away and died.

One of Miss Braddon's heroines says: "It is so nice to see a favorite horse looking over the door of his loose-box, with a big tabby-cat sitting on the window-ledge beside him." The big tabby would probably prefer being on horseback, for puss takes very kindly to the stable, and the horse takes as kindly to puss. A cat belonging to the royal stables at Windsor made herself so agreeable to one of the horses there that, rather than put her to any inconvenience, he would take his night's rest standing. This was held detrimental to his health, and the stable authorities, unable to hit upon any other plan, banished poor pussy to a distant part of the country.

Mr. Huntington, of East Bloomfield, New York, owns a thorough-bred horse named Narragansett and a white cat. The latter was wont to pay a daily visit to Narragansett's stall, to hunt up the mice and then enjoy a quiet nap. Mr. Huntington removed to Rochester with his family, leaving the cat behind; but she complained so loudly and

so unceasingly that she was sent on to the new abode. Her first object was now to get somebody to interpret her desires. At last her master divined them, and started off with her to the barn. As soon as they were inside, the cat went to the horse's stall, made herself a bed near his head, and curled herself up contentedly. When Mr. Huntington visited the pair next morning, there was puss close to Narragansett's feet, with a family of five beside her. The horse evidently knew all about it, and that it behooved him to take heed how he moved his feet. Puss afterward would go out, leaving her little ones to the care of her friend, who would every now and then look to see how they were getting on. When these inspections took place in the mother's presence, she was not at all uneasy, although she showed the greatest fear and anxiety if any children or strangers intruded upon her privacy.

A gentleman in Sussex had a cat which showed the greatest affection for a young blackbird, which was given to her by a stable-boy for food a day or two after she had been deprived of her kittens. She tended it with the greatest care; they became inseparable companions, and no mother could show a greater fondness for her offspring than she did for the bird.

Lemmery shut up a cat and several mice together in a cage. The mice in time got to be very friendly, and plucked and nibbled at their feline friend. When any of them grew troublesome, she would gently box their ears.—A German magazine tells of a M. Hecart who placed a tame sparrow under the protection of a wild-cat. Another cat attacked the sparrow, which was at the most critical moment rescued by its protector. During the sparrow's subsequent illness its natural foe watched over it with great tenderness.—The same authority gives an instance of a cat trained, like a watch-dog, to keep guard over a yard containing a hare, and some sparrows, blackbirds, and partridges.

A pair of carriage-horses taken to water at a stone trough, then standing at one end of the Manchester Exchange, were followed by a dog who was in the habit of lying in the stall of one of them. As he gamboled on in front, the creature was suddenly attacked by a mastiff far too strong for his power of resistance, and it would have gone hard with him but for the unlooked-for intervention of his stable-companion, which, breaking loose from the man who was leading it, made for the battling dogs, and with one well-delivered kick sent the mastiff into a cooper's cellar, and then quietly returned to the trough and finished his drink. In very sensible fashion, too, did Mrs. Bland's half-Danish dog Traveler show his affection for his mistress's pet pony. The latter had been badly hurt, and, when well enough to be turned into a field, was visited there by its fair owner and regaled with carrots and other delicacies; Traveler, for his part, never failing to fetch one or two windfall apples from the garden, laying them on the grass before the pony, and hailing its enjoyment of them with the liveliest demonstrations of delight.

That such relations should exist between the horse and the dog seems natural enough; but that a horse should be hail-fellow with a hen appears too absurd to be true; yet we have Gilbert White's word for it that a horse, lacking more suitable companions, struck up a great friendship with a hen, and displayed immense gratification when she rubbed against his legs and clucked a greeting, while he moved about with the greatest caution lest he might trample on his "little, little friend."

Colonel Montagu tells of a pointer which, after being well beaten for killing a Chinese goose, was further punished by having the murdered bird tied to his neck—a penance that entailed his being constantly attended by the defunct's relict. Whether he satisfied her that he repented the cruel deed is more than we know; but, after a little while the pointer and the goose were on the best of terms, living under the same roof, feeding out of one trough, occupying the same straw bed; and, when the dog went on duty in the field, the goose filled the air with her lamentations for his absence.

A New Zealand paper says: "There is a dog at Taupo and also a young pig, and these two afford a curious example of animal sagacity and confidence in the *bona fides* of each other. These two animals live at the native *pah* on the opposite side of Tapuaeharuru, and the dog discovered some happy hunting-grounds on the other side, and informed the pig. The pig, being only two months old, informed the dog that he could not swim across the river, which at that spot debouches from the lake, but that in time he hoped to share the adventures of his canine friend. The dog settled the difficulty. He went into the river, standing up to his neck in water, and crouched down; the pig got on his back, clasping his neck with his forelegs. The dog then swam across, thus carrying his chum over. Regularly every morning the two would in this way go across and forage around Tapuaeharuru, returning to the *pah* at night; and, if the dog was ready to go home before the pig, he would wait till his friend came down to be ferried over. The truth of this story is vouched for by several who have watched the movements of the pair for some weeks past."

When Cowper cautiously introduced Puss—a hare that had never seen a spaniel—to Marquis—a spaniel that had never seen a hare—he discovered no token of fear in the one, no sign of hostility in the other, and the new acquaintances were soon in all respects sociable and friendly—a proof, the poet thought, that there was no natural antipathy between dog and hare. Upon just as good grounds the same might be inferred regarding dog and fox. We have read of a tame fox hunting with a pack of harriers; and Mr. Moffat, of Bearsley, Northumberland, owned one that was excessively fond of canine society. In consequence of detection following a raid on the poultry-yard, Master Reynard was chained up in a grass area. Whenever he caught sight of a dog coming his way, he began fanning his tail, and, laying back his ears, would

strain desperately at the full length of his tether, that he might smell at the mouth of the dog, and use all his arts to induce him to have a romp, even though he had never set eyes on that especial dog before.

In 1822 some white rats were trapped in Colonel Berkeley's stables. Mr. Samuel Moss, of Cheltenham, took a fancy to a youngster, and determined to make a pet of him. He was soon tamed, and christened Scugg. Then he was formally introduced to a rat-killing terrier, a ceremony so well understood by Flora that she not only refrained from assaulting the new-comer, but actually constituted herself his protectress, mounting guard over Scugg whenever a stranger came into the room, growling, snarling, and showing her teeth, until convinced he had no evil intentions toward her *protégé*. These two strangely-assorted friends lapped from the same saucer, played together in the garden, and, when Flora indulged in a snooze on the rug, Scugg ensconced himself snugly between her legs. He would mount the dinner-table and carry off sugar, pastry, or cheese, while Flora waited below to share in the plunder. One day a man brought Mr. Moss another white rat, while the terrier and Scugg were racing about the room. The stranger was shaken out of the trap, and presently two white rats were scampering across the floor pursued by Flora. The chase did not last long, one of them quickly falling a victim to the terrier's teeth, much to the experimentalist's alarm, as his eyes could not distinguish one rat from the other. Looking around, however, his mind was relieved, for there in his corner was Scugg, with Flora standing sentry before him—a position she held until the man and the dead rat were out of the room. When his master took a wife to himself, a new home was found for Scugg; but the poor fellow died within a month of his removal, and it is not improbable that the separation from his canine friend was the primary cause of the rat's untimely decease.

St. Pierre pronounced the mutual attachment displayed between a lion at Versailles and a dog to be one of the most touching exhibitions Nature could offer to the speculations of the philosopher. Such exhibitions are by no means rare. Captive lords of the forest and jungle have often admitted dogs to their society and lived on affectionate terms with them. Not long ago, an ailing lioness in the Dublin Zoölogical Gardens was so tormented by the rats nibbling her toes that a little terrier was introduced into the cage. His entrance elicited a sulky growl from the invalid; but, seeing the visitor toss a rat in the air and catch it with a killing snap as it came down, she at once came to the sensible conclusion that the dog's acquaintance was worth cultivating. Coaxing the terrier to her side, she folded her paw round him and took him to her breast; and there he rested every night afterward, ready to pounce upon any rat daring to disturb the slumbers of the lioness.

The last time we visited the lion-house of the Regent's Park Zoölogical Gardens, we watched with no little amusement the antics of a dog, who was evidently quite at home in a cage occupied by a tiger and

tigress. The noble pair of beasts were reclining side by side, the tiger's tail hanging over the side of their couch. The dog, unable to resist the temptation, laid hold of it with his teeth and pulled with a will; and, spite of sundry gentle remonstrances on the part of the owner of the tail, persisted until he elicited a very deep growl of disapproval. Then he let go, sprang upon the tiger's back, curled himself up, and went off to sleep. Such friendships are, it must be owned, liable to come to a tragic ending, like that recorded by an ancient writer, who tells how a lion, a dog, and a bear, lived together for a long time on the most affectionate terms, until the dog, accidentally putting the bear out of temper, had the life put out of his body; whereupon Leo, enraged at losing his favorite, set upon Bruin and made an end of him too.—*Chambers's Journal.*

THE SCIENCE OF EASY-CHAIRS.

THERE is a reason for everything, if we can only find it out; but it is sometimes very hard to discover the reasons of even the very simplest things. Every one who has traveled much, and even those who have merely looked through books of travels, must have been struck by the variety of attitudes assumed by the people of different countries. The Hindoo sits down on the ground with his knees drawn up close to his body, so that his chin will almost rest upon them; the Turk squats down cross-legged; the European sits on a chair; while the American often raises his feet to a level with his head. Nor are the postures assumed by the same people under varying circumstances less diverse. Climate or season, for example, will cause considerable alteration in the posture assumed, as was well shown by Alma-Tadema, in his pictures of the four seasons exhibited in the Academy a year ago. In his representation of "Summer," he painted a woman leaning backward on a ledge, with one leg loosely hanging down, while the other was drawn up so that the foot was on a level with the body. In the picture of "Winter," on the other hand, we saw a figure with the legs drawn up in front of the belly. The reason for these different postures has been explained by Rosenthal. The temperature of the body, as is well known, is kept up and regulated by the circulation of the blood through it, and a great proportion of the blood contained in the whole body circulates in the vessels of the intestines. Now, the intestines are only separated from the external air by the thin abdominal walls, and therefore any change of temperature in the atmosphere will readily act upon them, unless they be guarded by some additional protection. The Hindoos are well aware of this, and they habitually protect the belly by means of a thick shawl or *cummerbund*, thus guarding themselves against any sudden change of temperature. This precaution is also

frequently adopted by Europeans resident in hot climates, and is even retained by them after returning to England. But the function of the *cummerbund* may, to a certain extent, be fulfilled by change of posture alone. When the legs are drawn up, as in the picture of "Winter" already referred to, the thighs partially cover the abdomen, and, taking the place of additional clothing, aid the abdominal walls in protecting the intestines and the blood they contain from the cooling influence of the external air.

Thus it is that in cold weather, when the quantity of covering in bed is insufficient, persons naturally draw up their legs toward the abdomen, so as to retain as much heat as possible before going to sleep. In hot weather, on the contrary, they wish to expose the abdomen as much as possible to the cooling influence of the atmosphere. The posture depicted by Alma-Tadema is the most efficient for this purpose. It no doubt answers the purpose to lie down flat on one's back; but in this position the abdominal walls are more or less tight, whereas, when one of the legs is drawn up as in the painting just alluded to, the walls are relaxed, and, the intestines not being subject to any pressure, the blood in them will circulate more rapidly, and the cooling process be carried on more effectually. In this attitude also the thighs are completely separated, and loss of heat allowed from their whole surface.

Varying conditions of fatigue also alter the postures which people assume. When slightly tired one is content to sit down in an ordinary chair in the position of the letter N with the middle limb horizontal. As we get more and more fatigued we usually assume positions in which the limbs of the N become more and more oblique, the trunk leaning backward and the legs extending forward. If we lie down in bed on our back the legs will probably become straight, but if we rest upon our side they will be more or less bent. The straightness of the legs in the supine position is simply due to their weight, which is then supported at every point by the bed, but when we lie on our sides the genuflection of the legs is most agreeable, because not only are the muscles more perfectly relaxed, but, as the late Prof. Goodsir pointed out, the bones which form the knee-joint are slightly removed one from another, and thus the joint itself, as well as the muscles, passes into a state of rest. Some of the bamboo easy-chairs manufactured in India allow us to obtain the advantages of both positions. These chairs are made in the form of a somewhat irregular, straggling W, and in them one can lie on one's back with every part of the body thoroughly supported, and the knees bent in the same way as they would be if one lay upon one's side.

Thus simple inaction, the relaxation of muscles, and the laxity of joints, are some of the factors necessary for complete rest, and an easy-chair, to be perfect, must secure them all.

But it is possible for an easy-chair to secure all these, and yet be imperfect. We have just said that usually, as the fatigue becomes

greater and greater, the tendency is to assume the position of the N with the limbs at a more or less obtuse angle, but when sitting in an ordinary chair we find relief from raising the feet by means of a foot-stool, although this tends to make the angles of the N more acute instead of more obtuse. Still more relief, however, do we obtain when the legs are raised up on a level with the body by being placed upon another chair, or by being rested on the Indian bamboo seat already described. If, in addition to this, the legs are gently shampooed upward, the sensation is perfectly delightful, and the feelings of fatigue are greatly lessened. To understand how this can be, it is necessary for us to have some idea as to the cause of fatigue. Any muscular exertion can be performed for a considerable time by a man in average health, without the least feeling of fatigue, but by-and-by the muscles become weary, and do not respond to the will of their owner so readily as before; and, if the exertion be too great, or be continued for too long a time, they will ultimately entirely refuse to perform their functions. The muscle, like a steam-engine, derives the energy which it expends in mechanical work from the combustion going on within it, and this combustion, in both cases, would come to a standstill if its waste products or ashes were not removed. It is these waste products of the muscle which, accumulating within it, cause fatigue, and ultimately paralyze it. This has been very neatly shown by Kronecker, who caused a frog's muscle, separated from the body, to contract until it entirely ceased to respond to a stimulus. He then washed out the waste products from it by means of a little salt and water, and found that its contractile power again returned, just as the power of the steam-engine would be increased by raking the ashes which were blocking up the furnace and putting out the fire. These waste products are partly removed from the muscles by the blood which flows through them, and are carried by the veins into the general circulation. There they undergo more complete combustion, and tend to keep up the temperature of the body. At the same time, however, according to Preyer, they lessen the activity of the nervous system, producing a tendency to sleep, and in this way he would, at least to some extent, explain the agreeable drowsiness which comes on after muscular exertion. It would seem, however, that the circulation of the blood is insufficient to remove all the waste products from the muscles, for we find that they are supplied with a special apparatus for this purpose. Each muscle is generally insheathed in a thin membrane, or fascia, and besides these we have thicker fasciæ insheathing whole limbs. These fasciæ act as a pumping apparatus, by which the products of waste may be removed from the muscles which they invest. They consist of two layers, with spaces between. When the muscle is at rest these layers separate and the spaces become filled with fluid derived from the muscle, and when the muscle contracts it presses the two layers of its investing sheath together, and drives out the fluid contained between them. This

passes onward into the lymphatics, where a series of valves prevents its return, and allows it only to move onward, till at last it is emptied into the general circulation.

In strong and healthy people the veins and lymphatics together are quite able to take up all the fluid which the arteries have supplied to the muscles, and thus prevent any accumulation from taking place either in them or in the cellular tissue adjoining them, or at least prevent any such accumulation as might become evident to the eye. In delicate, weakly persons, or in those who suffer from certain diseases of the vascular system, this is not the case; and after standing or walking for a long time the legs become swollen, so that the boots feel tight, and sometimes even a distinct impression may be remarked at that part of the ankle which was covered by the boot. In such persons we can actually see the swelling disappear, after the feet have been kept rested for some time on a level with the body, and it may be removed more quickly still by gently and steadily rubbing the limbs in one direction from below upward. It is almost certain that what we thus see in weakly persons occurs to a slighter extent in all, and that even in the most healthy person after a long walk a slight accumulation of fluid, laden with the products of muscular waste, occurs both in the muscles themselves and in the cellular tissue around them, even although we cannot detect it by simple inspection. So long as the limbs of such a person hang down, the force of gravity retards the return both of blood through the veins and of lymph through the fasciæ and lymphatics, and thus hinders the muscles from getting rid of those waste products which caused the fatigue. When the legs are raised, this hinderance is at once removed, both blood and lymph return more readily from the muscles, carrying with them those substances which had been formed by the muscles of the limbs during the exertions which they had undergone when carrying the body about. So long as these substances remained where they had been formed, they might cause in the muscles of the legs an undue amount of fatigue, although, when distributed over the body generally, they may produce only a pleasing languor. When the legs are long, the obstruction to the return of blood and lymph is, of course, greater than when they are short, and this return will take place more readily when the legs are raised above the body than when they are only on a level with it. This may be one of the reasons why some of our long-legged American cousins are so fond of raising their feet to a level with their heads, or even higher, although it is very probable that there are reasons still more powerful, which we may discuss at a future time.

It has already been mentioned that the lymph is propelled along the interstices of the fasciæ into the lymphatic vessels by the intermittent pressure which the muscle exerts upon them from within; and it seems natural to suppose that the flow may also be aided by a pressure from without, in the form of shampooing. Even when the hand is rubbed

backward and forward upon the leg it will relieve fatigue, but the relief is greater when the leg is firmly grasped and the hand moved gently upward so as to drive onward as much as possible any fluid which may have accumulated in the limb, and, the grasp being then relaxed, the same process should be repeated.

But, while the lymph is thus most readily removed by the pumping action of intermittent pressure either of the hand without or of the muscles alternately contracting and relaxing within, it seems to us probable that this process may also be aided by steady, constant pressure from without. No doubt it is impossible for such a steady pressure to take the place of the regular pumping action produced by the alternate contraction and relaxation of the muscles when in action, yet it will have a somewhat similar action, though to a very much less extent. For at each beat of the heart, as Mosso shows, the entire limb is distended by the blood driven into the vessels, and during the pauses between the beats it again becomes smaller. Each pulse, therefore, by distending the whole limb and each individual muscle, will press out a little of the fluid contained in the fasciæ in the same way as the contractions of the muscles themselves; and it seems to us probable that it is the aid which is afforded to this process, by the gentle pressure exerted on the outside of the legs by a seat which supports them along their whole extent, that renders such a seat so peculiarly restful and agreeable. For an easy-chair to be perfect, therefore, it ought not only to provide for complete relaxation of the muscles, for flexion and consequent laxity of the joints, but also for the easy return of blood and lymph not merely by the posture of the limbs themselves, but by equable support and pressure against as great a surface of the limbs as possible.

Such are the theoretical demands, and it is interesting to notice how they are all fulfilled by the afore-mentioned chair in the shape of a straggling W, which the languor consequent upon a relaxing climate has taught the natives of India to make, and which is known all over the world.—*Nature.*

LANGUAGE AND THE EMOTIONS.

By Dr. CHARLES WALDSTEIN.

THE following passage in De Quincey's "Walking Stewart" is well worth noticing: "The character of a nation may be judged of in this particular, by examining its idiomatic language. The French, in whom the lower forms of passion are constantly bubbling up from the shallow and superficial character of their feelings, have appropriated all the phrases of passion to the service of trivial and ordinary life, and

hence they have no language of passion for the service of poetry, or of occasions really demanding it, for it has been already enfeebled by continual association with cases of an unimpassioned order. But a character of deeper passion has a perpetual standard in itself, by which as by an instinct it tries all cases, and rejects the language of passion as disproportionate and ludicrous where it is not fully justified. 'Ah, Heavens!' or 'O my God!' are exclamations with us so exclusively reserved for cases of profound interest that, on hearing a woman even (i. e., a person of the sex most easily excited) utter such words, we look round expecting to see her child in some situation of danger. But in France, 'Ciel!' and 'O mon Dieu!' are uttered by every woman if a mouse does but run across the floor. The ignorant and the thoughtless, however, will continue to class the English character under the phlegmatic temperament, while the philosopher will perceive that it is the exact polar antithesis to a phlegmatic character."

There is a great amount of truth in this passage. The too frequent use of strong language may indurate and blunt our feelings, as excessive indulgence in alcoholic stimulants deadens the sensibility of our palate. And there can hardly be a doubt but that the frequent use of words disproportionate in their strength to the thoughts and feelings in whose connection they are used has detracted from the original strength of the French language. Naturally the strongest word ought to be used to give expression to the strongest feeling. But strong words have been so blunted through frequent use that they have lost their sharp edge, and pass over our thick skin without even pricking our sensibility; while, at moments when we expect a heavy blow, the light tickling of the socially polite feather may far more vividly stimulate our sensibility. It may be said that this disparate use of words is the essence of sarcasm, and that sarcasm is naturally strong. But the use of sarcasm itself indicates an abnormal state of mind, and its frequent cultivation during a certain epoch, or in a certain country, is almost an infallible symptom of disease in some quarter. When polite and otherwise weak words are used in a powerful context, it is almost invariably a sign of over-frequent and hackneyed use of strong words. There are many instances of this in France. Among them let us examine one of recent date and of great interest, because of its publicity and because of its author—the most powerful writer of the age. Of all Victor Hugo's writings this letter is one of the most characteristic specimens; not because of the strong words of which it consists, but, on the contrary, because of the colloquial, polite phraseology with which it begins, on an occasion when one would rightly expect the words which are used when—a stray dog has sprinkled a drop of mud on our newly-blacked boots.

"MONSIEUR: Vous faites une imprudence." (We expected an outburst of deeply-felt passion.). . . . "Tout cela a été dit. Je n'y insiste pas. Je dédaigne *un peu* les choses inutiles.

"Vous insultez Voltaire, et vous me faites l'honneur de m'injurier. C'est votre affaire.

"Nous sommes, vous et moi, deux hommes quelconque. L'avenir jugera. Vous dites que je suis vieux, et vous me faites entendre que vous êtes jeune. *Je le crois.*

"Le sens moral est encore si peu formé chez vous, que vous me faites 'une honte' de ce qui est mon honneur.

"Vous prétendez, monsieur, me faire la leçon. De quel droit? Qui êtes-vous? Allons au fait. Le fait le voici: Qu'est-ce que c'est que votre conscience, et qu'est-ce que c'est que la mienne?

"Comparons-les.

"Un rapprochement suffira," etc.[1]

And now he launches into a grand and dignified comparison, in which the words used are quite adequate to the weight of the feelings expressed.

No doubt there are other elements which contribute their share to make this letter so strong in style: as, for example, the great *crescendo* of the whole, which gradually and with a continual bridling in shows us the growing speed and bulk of his feelings, until they burst forth in grandeur. Then, again, we feel that the person who wrote this is on the one hand a man of the world, who can constrain passionate outbursts, and this prepares us for the subsequent great effect when his passion is let loose; for the man of the world is not the man of the street, who uses weighty language for light occasions. On the other hand, we hardly need fear, with Victor Hugo, that we may find the "typical" man of the world who has lost all power of passion in habitually repressing it; and we are prepared to receive the full meaning of deep words when they come.

However, the passage exemplifies what I mean. Instead of the word "imprudence," we expect something meaning unworthy, immoral action, or insolence. Instead of "un peu," we expect "profondément," etc. It will be seen that the whole beginning is in a tone of lightness which we would almost expect to notice in two gentlemen conversing in some public place quite simply, though without smiling. Still the essence which underlies the form is intensely passionate.

The reaction against this abuse of strong language may lead, on the one hand, to this disproportionate use of lighter words, or, on the

[1] "Sir, you are indiscreet. . . . That has already been said. I do not insist upon it. I *rather despise* useless things.

"You insult Voltaire, and you do me the honor to revile me. That is your affair.

"You and I are two men—what manner of men the future will decide. You say I am old, and you give me to understand that you are young. *I believe it.*

"In you the moral sense is still so undeveloped that you pronounce that in me 'a shame' which is my honor.

"You presume, sir, to read me a lecture. By what right? Who are you? Let us come down to facts. Here is fact: What is your conscience, and what is mine?

"Compare the two.

"A comparison will be enough," etc.

other hand, to a return to coarseness. In coarseness there is still an element of strength ; the terse monosyllable which Bayard gave as a retort to the summons of surrender is an instance. Had he said, "Après vous, messieurs!" it would almost have been equally strong. The coarseness of some of the earlier English novelists, I think, was chiefly a reaction against the French manners of former periods. In my limited personal experience, I have found that many young men, who had spent their days with the ideal of "good form" before them, have taken a childlike delight in using vulgar language when free from restraint.

Language is to a certain extent an indicator of national character. But we must not be led to a one-sided statement of the case. There is an abuse, as well in the neglect or disuse of words expressive of feeling as in the too facile application of such words. And I believe that there is a faulty implication in De Quincey's remark quoted above, especially in its application to the English character—the implication, namely, that, where there is no verbal demonstration of feeling, we may infer a greater depth of feeling. In fact, one frequently hears this asserted, and the proverb, "Still waters run deep," has contributed to confirm such a belief. But this must not be hastily accepted. I believe that it is the extreme and just opposition against the equally faulty assertion that, where there is no demonstrative feeling, there is no feeling whatever. Falsehood, luckily, is not the normal manner of expression, notwithstanding the proposition that "*la parole a été donné à l'homme pour cacher sa pensée;*"[1] and therefore I am inclined to believe that, *cæteris paribus*, feeling is more likely to be present where we can perceive the outward signs of its existence, than where there is no sign whatever ; as I am more inclined to believe that preciseness and firmness of character are more likely to be possessed by the man who takes great pains with the neatness and cleanliness of his person and attire than by one who does not. But there are action and reaction between the care of the person and the cast of the character; e. g., cleanliness may be the outward expression of certain traits of character, and when practised may again produce, or strengthen, or prolong these traits. All education rests upon the fact of this interaction. We see what is the desirable cast of mind by its outward manifestations, and try to ingraft such a mental attitude by habitual practice of these manifestations. It has been suggested to me in conversation that the fact of the lower orders, especially in the country, wearing their "Sunday best," and generally attending to the neatness of their appearance on Sundays, has a reviving and improving effect upon them. The work-day customs, with rough language and more or less brutal indulgences, are cast away with the work-day clothes, and there is a strong feeling that outbursts would be out of keeping with such fine dress, and that a man must act up to his (genteel) appearance.

[1] Language was given to man to hide his thoughts.

Words are not merely the indications of feeling, but they may also react upon our feelings, modify them, in some cases even produce new groups of emotions.

If the emotions are a desirable and essential element of the human mind, and if language can thus react upon our emotional nature, the expression of these desirable emotions ought not to be neglected, but even positively cultivated. If we compare the German language with the English, we are struck by the poverty of the latter as regards the expression of emotions, and especially of those indicating contentment.

The wealth of the German language in expressions of feeling and general moods admits of no doubt. In what language do we meet with such a wealth of words expressing mental pain, from the most marked shadings down to the finest, until pain gently overlaps into pleasure? Let us attempt an incomplete enumeration of such expressions, omitting the numerous foreign words (such as Melancholie, Apathie, Misere, Agonie, Tortur, etc.), which have been embodied in German idiom: Verzweiflung, Marter, Pein, Jammer (Herzensjammer), Elend, Gram, Kummer, Leid (Herzeleid), Herzensnoth, Herzensangst, Bangen, Trauer, Harm, Betrübniss, Trübsal, Trübsinn, Unglück, Schmerz, Weh, Unlust, Schmachten, Hinschmachten, Hindarben, Vergehen, Hinbrüten, Schwermuth, Wehmuth, Sehnsucht, Sehnen, Drängen, etc. Besides these there are numerous expressive compounds.

Now, it is true that the German, as well as every language, is richer in words expressive of grief than of joy; and this is a characteristic common to all language, because it springs from psychological facts common to all men. We do not so readily express our joy as our grief, because, in the first place, grief is more dignified than joy. We do not like to show our joy, because it is easily unbridled, and the boundless is less comely than the bounded. Joy is elation, which implies opposition to the usual fetters and to form; while grief is a contraction, which implies a closer sinking into form, and seeks the plastic. The facial expression of joy and grief corresponds to this—nay, perhaps was a cause in determining our inclination or repugnance as regards the expression of these emotions. Joy manifests itself in an expansion of the facial muscles, and avoids the eye of the sculptor who wishes to render a beautiful harmonious display of features. The sinking and contraction of grief, on the other hand, bring out more markedly the fine features and the modeling. Then, again, elation means motion and unrest; it points to restless diffusion, while contraction must end, and points to quiet and rest; and therefore sculptors, to whom to a great extent we owe the creation of the ideal of human beauty, rendered the latter and shunned the former.

In the second place, sympathy, if sought by the happy, is less sure to be obtained; for man has the evil tendency to envy, and, though it is easy for him to feel the delight of compassion and pity, he is more grudging with his sympathy with others' joy. He has also the ten-

dency to egoism. Joy has less need of sympathy: the happy are apt to be self-sufficient. He can afford to share some of his pain with his brethren; but joy is a matter much in demand, and he cannot well spare a particle of it—that, unless it can be increased by division, is devoured alone.

And, finally, there are fewer expressions of joy, because contentment is essentially a unit, is one, or at least is so in its perfect state, toward which we strive. There is a homely German saying, "Satter wie satt kann man nicht werden." Satiety is the *one* point, and all that is above or below this point is not enjoyable. When we are contented we have arrived at the normal state of existence; there is no other way of expressing it, for it is unique, and cannot be split into various shadings. And we are generally driven to express different shadings of joy by the physical concomitants of that feeling, as elation, thrilling, etc. It is the one positive point.[1]

All these causes will evidently influence lyric poetry, the musically-poetical expression of emotions. It is very difficult to say more than that we are happy, while we may tell many things of our peculiar feelings of misfortune. And we are not inclined to show our smiling face without hope of having it reciprocated; while we may fail to reproduce in our readers the sad mood which drove us to write a sad poem and still not feel ridiculous. The measured tone of sad words and their context is more adapted to musical rhythm than the rapid, short expressions of mirth. As in sculpture the woful expression is more plastical than the joyful, so in poetry the sad strives toward harmonious form more readily than the happy, and therefore we shall have fewer poems expressive of joy than of sorrow.

But to return to the main topic: The greatest distinction between the German and English language is perceived when we compare the expressions of the bright side of emotions. Let us again attempt an incomplete enumeration, omitting the numerous foreign words adopted into the German language, as well as the compounds which express so definitely certain fine shadings: Entzücken, Ergötzen, Tubel, Wonne, Seligkeit, Glückseligkeit, Freude, Freudigkeit, Glück, Lust, Vergnügnen, Frohsinn, Frohmuth, Heiterkeit, Munterkeit, Scherzhaftigkeit, Ausge-

[1] I hold, in opposition to the pessimists, that this fact of the poverty of expressions of pleasure as contrasted with the multiplicity of expressions of pain goes to prove the *positive* nature of pleasure. The pessimists hold that pain is positive and pleasure negative, i. e., that pleasure is the absence of pain; the intermissions in the long chain of bodily and mental pains are to them pleasure. In logic the positive thing is definite and one, while the negative is indefinite and multiple. So "A" would be positive, definite, and would denote one thing; while "Not A" is negative, indefinite, in fact, denotes anything or all things in the universe excepting "A." Therefore, when the pessimist points to the wealth of expression in pain, and to the poverty in expressions of pleasure, and when he points to the difficulty of defining contentment, while pain comprises so many states, he has not disproved the positive nature of pleasure. On the contrary, we find that the simpler and more positive a fact is, the more difficult is it to define, until we are limited to the mere mention of the fact.

lassenheit, Launigkeit, Schalkhaftigkeit, Wohlbehagen, Zufriedenheit, Gemüthsruhe, etc.

Now, some of these words have been and are still in use in the English language; but they have suffered strange usage. They have degenerated to lightness, losing their original weight and dignity, or they have been actually lowered and have received an evil connotation. And we generally find that the Latinized words degenerate in the direction of levity, while the Saxon words degenerate in the direction of vulgarity.

As an instance of the first case, the English words corresponding to Glück and Unglück are Fortune and Misfortune. The dark side of these ideas, Misfortune, has retained the strength and dignity corresponding to the German. Fortune, however, does not correspond to Glück as Misfortune corresponds to Unglück. It may be urged that Fortune had already lost its deep meaning in the Latin, perhaps because of the fickle and worldly character which poets attributed to the goddess Fortuna; but the difference in the comparative depth of signification between Fortune and Misfortune illustrates what I mean. Fortune has more and more turned toward a signification of luck or chance, or to an expression of the most worldly accidents of happiness, as wealth, etc. When the German says, "Ich bin glücklich," he means to indicate a state of high satisfaction; but, when we say, "I am fortunate," it conveys the impression of a transitory state of satisfaction; in fact, we are not necessarily happy or contented, the accent is not thrown upon our own mood, but upon some outer fact, for we would naturally ask, "Fortunate *in what?*"

As an instance of the second case, we find the word Lust still used in English, but in what an altered meaning from the German! In German, Lust denotes a wide, high, and intense pleasure. It would not be amiss in German to speak of the "high Lust of the converse with God in prayer."[1] The wide compass of this word is beautifully illustrated in that untranslatable poem in Goethe's "West-oestlicher Divan," in which Lust is brought in connection with rose-water which cost the life of a whole world of flowers, and with the great historical event of Tamerlane's (Timour) inroad which also cost the life of myriads of existences:

"Dir mit Wohlgeruch zu kosen,
Deine Freuden zu erhöhn,
Knospend müssen tausend Rosen
Erst in Gluthen untergehn.

"Um ein Fläschchen zu besitzen
Das den Ruch auf ewig hält,
Schlank wie deine Fingerspitzen
Da bedarf es einer Welt;

[1] We are reminded of the story of a German missionary in Australia, who, ignorant of this degeneration of Saxon words, exhorted his congregation "to do the will of God with *craft* and *lust*."

"Einer Welt von Lebenstrieben,
Die, in ihrer Fülle Drang,
Ahneten schon Bulbuls Lieben,
Seeleregenden Gesang.

"Sollte jene Qual uns quälen,
Da sie unsre Lust vermehrt?
Hat nicht Myriaden Seelen
Timur's Herrschaft aufgezehrt?"

It is true, the word Lust in English is not exclusively used in the lowest animal sense, but has been applied in a more intellectual connection; so we speak of the "lust of empire," the "lust of power," etc. But there is undoubtedly always an admixture of evil and of disapproval, and some hidden analogy to animal desire. With Chaucer, still, "luste" is used both as a noun and verb to signify wish, desire, pleasure, enjoyment, without an evil connotation.[1] The causes of this degeneration are numerous. But two seem to me most worthy of notice. It is a well-known fact that, after the Norman Conquest, the language of the conqueror, French, became the language of the aristocracy. This

[1] In the "Canterbury Tales:"

Clerkes Tale.

"His lustes were al lawe in his decree
For fortune as his friend wolde him obeye.

Right as yon lust governe the matter.

Wherefore I yow preye
Doth your plesaunce, I wol your lust obeye.

But on his lust present was al his thought
As for to hauke and hunt on every syde."

Squyeres Tale.

"But thus llete in lust and iolitee
This Cambyskam his lordes festeyinge
Til wel ny the day began to springe.

The knotte why that every tale is told
If it be taried til the lust is cold.

If hir lust it for to were
Upon hir thombe."

Man of Lawes Tale.

"Al his lust and al his busy care
Was for to love hir while his lyf may dure."

"To do hir lust" (will, pleasure) is very common, and originally lust was used in the sense of list (the *opposite* sense, listless, still obtains), to do anything with pleasure, enjoyment. The word *lusty* Chaucer also uses like the German *lustig*, meaning merry, jovial (the lusty playne, the lusty somer, etc.). The noun lustiheed (joviality), corresponding to the German Lustigkeit, is also used:

"Therefore I passe of al this lustiheed."
(*Squyeres Tale.*)

has manifested itself in the fact that the raw materials of food—cattle, etc.—retained their Saxon names, such as calf, ox, sheep, etc., while the prepared meat is called by the French terms, beef, veal, mutton. Words used by the aristocracy will retain a high and polite signification, while the corresponding words in Saxon used by the vulgar will be spurned by the higher classes, and will receive a vulgar stamp.

Another striking instance of the vulgarizing influence of the Norman Conquest upon the Saxon vernacular is afforded by the word "buxom." In Anglo-Saxon *beogan*, *bugan*, and *bocsum*, it still obtains in the German, *biegen*, *biegsam*. In German it has retained its original meaning of bendable, pliable, slender, etc. In a mental sense it meant obedient (pliable), as "Under obedience to be and buxum to the lawe" ("Piers Plowman," about A. D. 1362). In Chaucer ("Clerkes Tale") we have it in its original physical meaning: "And they with humble entent buxumly—knelynge upon hir knees ful reverently." But in English we find a strange alteration in its meaning as applied to the human female figure. I may venture upon the following hypothesis with regard to the history of this word: Originally, I believe, this word was applied to the female figure to denote grace, litheness, slimness. If I remember rightly, some modern poet uses the word in that sense; the "buxom willow," or in some similar context. It would then convey the attribute of pliability and grace which is given in the words of Musset addressed to a lady: "Dans nos valses joyeuses je vous sentait dans mes bras plier comme un roseau." So, I venture to say, the word buxom was frequently applied to graceful, slender girls as a mark of high admiration. After the Norman Conquest, I suppose this to have been the action on the part of those who struck the key-note of *bon-ton*. Consciously, or half-consciously, the following train of thought seems to have pressed itself upon those of a markedly aristocratic turn of mind: "The people is essentially a distinct body from us, the aristocracy, especially the woman whom we admire so much. The words of the people must denote the attributes of the people: the lady is graceful, etc.; the woman is healthy, stout, red-cheeked, etc.—the lady dances, and we can feel her 'se plier comme un roseau,' but not the peasant-woman." Now, they found the word buxom indicating beauty in the woman of the people, they therefore influenced language, so that "buxom" conveyed the meaning of the beauty peculiar to the woman of the people.

Such a process is not restricted to the historical development of England; but we meet with it repeatedly in history, whenever there is this bloodless intellectual and linguistic warfare between classes. In Germany, e. g., the purely German words were repressed in meaning in proportion as the French gained footing as the language of the courts and of polite society through Frederick the Great and the subsequent Napoleonic influence. The Frau and Frauenzimmer assumed a lower connotation the more the word "madame" was used in connection with

ladies. At present there is a strong reaction against the French idiom in German. Politics and language are closely linked together in their bearing upon one another, and loss in political prestige precedes repression of idiom.

During the time of the Revolution we might have expected a revival of the old word, such as Lust; but the Revolution was puritanic in spirit, and so, instead of being reinstated it was still more repressed, for Puritanism with its stern features was ever averse to expressions of joyful emotions. Only such joy as partook of a lofty, aspiring character was cultivated, and the amiable and light-hearted was immediately stamped as frivolous. I think we must look to Puritanism for an explanation of one curious fact in these expressions. We find many expressions of exalted joy, of temporary pleasurable states (as a contribution from the French), and of the lower pleasure which is to be spurned. But we hardly find a powerful word which expresses a lasting state of pleasure, comprising as well the smallest satisfaction as the loftiest happiness—I mean a word corresponding to the German Glückseligkeit and the Greek *εὐδαιμονία*. In the German word the "glück" comprises all real happiness of life, and the "seligkeit" the most exalted spiritual happiness, and both combine to a lasting positive whole. A person would hardly be shocked were an Epicurean (a follower of the philosophy of Epicurus, I mean) to tell him that "Glückseligkeit was the aim of life," for this would include the highest moral satisfaction; while many people would be shocked to hear that "pleasure," or even "happiness, is the aim of life." This I attribute chiefly to the fact that the Puritan spirit drew a marked line between pleasures: there were exalted pleasures, and there were low pleasures; the first are desirable, the rest are to be repudiated, and there is no middle way.

This spirit, of course, did not always reign supreme, and the natural tendency is never totally to be extinguished, and we have some Saxon expressions of light mirth. But to this spirit, and other natural and historical causes, I attribute the fact that the dark side of expressions has been developed in England out of proportion with the bright side. So, for instance, we find that the German word Mitgefühl is rendered by the English "sympathy." This word, which means a "feeling with," originally meant a "suffering with." But while the German can subdivide this "feeling with" into with-joy and with-suffering (Gönnen, Mitfreude, and Mitleid), the English have two expressions of with-suffering, compassion, and pity, but have no expression for with-joy. One may mention that congratulation[1] conveys this meaning; but, though

[1] A curious instance in actual life which corroborates my statement was told me by a friend. A *naïve* and open-hearted lady was complaining to my friend of the difficulty she experienced in expressing her gratification to a relative who had been blessed with a baby. "You see," naïvely said this feeling person, "I can hardly express to her how truly I experience her joy, how I the-very-opposite-of-grudge" (she needed the German

it originally meant a sharing of joy, it has degenerated into a far lighter sphere, and has become a mere word of polite language, so that the illiterate will hardly recognize the original meaning from its present use. To use that French word to convey a deep feeling would be like using the word "plaisir" in German to express deep joy. The effect is similar to what it is when Heine, after his protestation of deep feeling, bursts forth with the French "*Madame*, ich liebe sie!"

Now, I am inclined to believe that where there is no expression for such a feeling, and where we rarely find such feelings expressed in other ways, such feelings are not so likely to exist, and, in truth, the ideal of "good form," which cripples the nature of many young men at a time when their emotions are still developing, goes to suppress the expression of any such feelings. One may frequently hear young men express their disapproval of others; but I think that I am not making a hasty statement when I maintain that one hears young men expressing their approval of others far less frequently in England than in Germany, though it is not unmanly nor ungainly to express one's liking of a third person, and one's joy with another, and this expression may have good effects, as well upon the sociable character as upon the whole emotional nature of men.[1]

But "good form" and other causes are contributing to impoverish the English language in expressions of original emotions. We notice the avidity with which people grasp at slang, because it has such original life. Were it not for the wide-spread knowledge of Shakespeare, I verily believe that our emotional language would be sorely crippled. There are desirable emotions, and they can be cultivated. Language is a means of cultivating them. There is a great difference in the mental cast of those who know but one language and those who know several, even if they have never left their home. The latter are possessed of broader vision and feeling, they have *learned* new feelings. When we have learned the true meanings of the French word "chic" and the German word "Gemüthlichkeit," we may have learned something the existence of which was unknown to us before. If we can force people to express "Mitfreude" we may perhaps teach some how

"gönnen") "her the blessing. Had her child died, I should have had many expressions at my service."

[1] Niebuhr, the great admirer of Englishmen, has remarked: "It is quite a national trait not to dwell upon what concerns us personally, upon what fills our heart; and it is as unnatural to them to hear me speak of the topics upon which I feel strongly as it would be to do the same themselves. How I shall bless the time when this constraint will be over, when in my own land I shall listen to the joys and sorrows of others, not as a mere piece of news, but as a communication to which I have a right, and be as sure of a welcome when I lay open my own heart! I am far from attributing it to coldness in these good people. It is altogether national, and it is the same with every one I have known here, whatever their rank or calling, learning or sex."—(From "The Life and Letters of B. G. Niebuhr, with Essays, etc.," by the Chevalier Bunsen, Professors Brandis and Loebell; translated by M. Winkworth.)

to feel it. If the language is poor in expressions it can be made richer. Coining of words ought not to be condemned *a priori*. It is self-regulating. If a person thinks something worth thinking, or feels something worth feeling, and cannot find an adequate expression, let him coin a word—if possible, one which manifestly conveys his meaning. He will have to be careful, for the public will reject what is useless, ridicule a blunder, but perhaps adopt what is suitable.

BIOLOGY AND "WOMAN'S RIGHTS."

SINCE natural history was remodeled by Mr. Darwin it has been found capable of throwing valuable lights, previously little anticipated, upon topics quite unconnected with the origin and attributes of zoölogical or botanical species. Of this solidarity of the sciences—one supplying another with methods of inquiry—a striking instance is afforded by a recent work,[1] in which the doctrine of natural selection is successfully utilized in the study of certain political subjects. That further applications more or less analogous are still possible will scarcely be doubted. There is in particular one question now agitating human society which seems particularly to require such treatment. Every one knows that of late years a movement has sprung up to secure for women, as contradistinguished from men, certain rights, liberties, and powers, of which it is contended they have been arbitrarily and wrongfully deprived. To define this movement, and to formulate distinctly the demands of its supporters, is a scarcely possible task. Innovators and agitators of all kinds enjoy the advantage that they cannot be tied down to any fixed set of propositions by which and by whose logical consequences they are prepared to stand or fall. On the contrary, if one ground is found untenable, another is instantly taken up; what satisfies one champion of the cause is rejected by another; and what to-day is accepted as final—as in the case of the anti-vivisection movement—is to-morrow proclaimed a mere installment, and made the basis of fresh demands.

Perhaps we may best describe the movement as an attempt to obliterate all—save the purely structural—distinctions between man and woman, and to establish between them a complete identity of duties and functions in place of that separation which has more or less hitherto always existed. That certain speakers and writers, not content with mere identification, go on to inversion, and would assign to men the particular tasks now allotted to women, though a significant fact, need not detain our attention.

It is of no use laughing at this agitation as the outcome of a mere

[1] "Physics and Politics," by Walter Bagehot. ("International Scientific Series.")

"crotchet." In certain states of the moral atmosphere crotchets spread just as do epidemics—which they closely resemble—in certain conditions of the physical atmosphere and other surroundings of man. Who would attempt to deal with the cholera or the small-pox by ridicule, how pungent and incisive soever?

We purpose, therefore, to examine this movement in the light of the principles of natural selection, of differentiation, and specialization, and to inquire whether the relations of the sexes in the human species and the distribution of their respective functions are or are not in general harmony with what is observed in that portion of the animal kingdom which lies nearest to man—to wit, in the Mammalia. With the origin and history of the agitation, with the hopes and motives of its supporters, and with the ethical, sentimental, economical, and political arguments used on either side we have no direct concern.

Even a very superficial and popular survey of the class Mammalia will satisfy us that the structural differences between the males and the females of each species are by no means confined to the reproductive organs. The male ruminant, whale, bat, elephant, rodent, carnivore, or ape, is on the average a larger and heavier animal than his mate. The tiger, for instance, exceeds the tigress in size by a proportion of from ten to twenty per cent. In few, if any, species is the superior stature of the male more striking than in the one which approaches man most nearly in its physical development—the gorilla.

But the mere difference in size is not all; the female is scarcely in any normal case a mere miniature copy of the male. Her proportions differ; the head and the thorax are relatively smaller, the pelvis broader, the bones slighter, and the muscles less powerful. The male in many cases possesses offensive weapons which in the female are wanting. In illustration we need only refer to the tusks of the elephant and the boar, and the horns of many species of deer. On the contrary, there is no instance of a female mammal possessing any weapon which is not also found, to at least an equal degree, in the male.

Further, the superior size of the head in the male is not merely due to the more massive osseous growth needful for the support of tusks, horns, etc., but to a proportionately larger development of brain. Thus, according to the recent investigations of M. le Bon,[1] "taking the mean weight of seventeen brains of human males, of 154 to 164 centimetres in height, and comparing them with the brains of seventeen women of the same stature, we find between the two a difference of 172 grammes (nearly six ounces) in favor of the male."

Summing up these facts, commonplace but not the less important, we see that in the whole mammalian class, man included, the males are distinguished from the females, not merely by larger size, but by superior cerebral and thoracic development, and by the more general possession of offensive weapons. On the other hand, trite as the remark may

[1] *Comptes-Rendus*, lxxxvii., No. 2, p. 80.

seem, the organs for the nutrition of the young are exclusively confined to the female. Are we to suppose that these sexual differences are devoid of meaning, merely accidental, or artificial in their origin?

We must next inquire to what functional distinctions these structural differences correspond, and what is their signification? It is generally admitted that among animals of one and the same species the larger will be found to be the stronger, and generally speaking physically the superior. Exceptions doubtless occur, but, if we were to take one hundred men in normal health whose "fighting-weight" ranged from eleven to twelve stone each, and compare them with another hundred averaging a stone less, we should find the former set able to lift greater weights, strike harder blows, and in every way excel the second lot in athletic performances.

Again, it is found that the size of the chest, and consequent volume of the lungs, affords a very good standard by which the general vigor, the vital energy, of either man or beast, may be gauged. The more a man, free from corpulence, measures round the chest, the better are his stamina, and the greater his power to support fatigues and hardships. Of this fact the military and the sporting world are perfectly aware, and never fail to take it into account in estimating the eligibility of a recruit or the probable performances of an athlete.

Having seen, then, that male animals are not merely actually larger than their respective females, but surpass them proportionally in the size of the thorax, we naturally expect the former to be decidedly the stronger, gifted with a more intense and exuberant vitality. Nor are our expectations disappointed. The bodily strength of a cow is trifling indeed compared with that of a bull of the same breed. In races a filly is very frequently—merely as such—allowed to carry less weight than a horse. A lady gorilla would be in evil case indeed if her husband did not treat her with a gentleness and kindness which many of our own species would do well to imitate. And as to mankind—is not, perhaps, the most legitimate source of the very movement we are criticising an attempt to secure women against the superior strength of men? Yet at a meeting at Manchester a male agitator actually sought to deny the superior physical power of man, because it would be easy to find a fish-wife stronger than a cotton-weaver. The argument, being intensely illogical, was frantically applauded.

Persons are not, however, wanting who—while admitting the general inferiority of women to men in physical strength—contend that this weakness is the result of continued and systematic repression. Woman, they say, has been forcibly debarred from invigorating pursuits, and comparative feebleness is the natural result. We would ask such advocates whether this systematic repression has been also carried out among the lower mammals, and, if not, what is the origin of the weakness of the female sex in their case, which is at least as well marked as among mankind? Has the "subjugation" of woman had

its parallel in the "subjugation" of the cow, the mare, the ewe, the lioness?

That the women of the middle class in all civilized countries, and of the higher in some, would be much healthier and stronger if they took more exercise in the open air and swallowed less tea, we admit. But in that case we contend that their increased vigor would descend not to their daughters exclusively or specially, but to all their children.

Further, in some countries and among certain classes, a great amount of physical labor falls to the lot of the women, without their being thereby rendered equal in strength to the men. Among the North American aborigines the squaw has the monopoly of hard work, while her husband—save when on the chase or on the war-path—indulges in idleness. Yet he runs no risk on that account of being surpassed in strength by his wife, and ultimately finding himself in consequence "subjugated."

No less is the superior cerebral development of the male sex in the human species, to which we have already referred as an indisputable fact, devoid of functional importance. It has, indeed, been contended that the difference in weight between the brain of the two sexes is a mere "survival" from some lower state of civilization, or of existence which we may expect to see ultimately disappear. Such hopes, if they anywhere exist, must be abandoned in view of the results of M. le Bon, already quoted. This biologist finds that "the difference between the respective weight of the brain in man and woman constantly goes on increasing as we rise in the scale of civilization, so that as regards the mass of the brain, and consequently in intelligence, woman becomes more and more differentiated from man. The difference which exists between the mean of the crania of contemporary Parisian men and that of contemporary Parisian women is almost double the difference which existed in ancient Egypt.

Taking hold of this simple fact, that the brain in the male is not merely larger, but increasingly larger, than in the female, we need not long search for its meaning. As the same writer to whom we have referred declares, "On examining series of crania sufficiently numerous we find that in the human species the largest brains belong to the races highest endowed intellectually, and in each race to its most intelligent members." Just, therefore, as higher civilization is heralded, or at least evidenced, by increasing bulk of brain; just as the most intelligent and the dominant races surpass their rivals in cranial capacity; and just as in those races the leaders, whether in the sphere of thought or of action, are eminently large-brained—so we must naturally expect that man, surpassing woman in volume of brain, must surpass her in at least a proportionate degree in intellectual power. We are sorry to be compelled here to own that while we know that in most, if not all, mammalian species the brain of the male exceeds in size that of the female, we have no observations as to any corresponding difference in mental

power. That such difference, on careful examination, will be found to exist is highly probable; but we must likewise expect that it will be found less distinctly marked the lower the rank of the species.

To return: the intellectual superiority thus claimed for the male sex, in virtue of a higher cerebral development, is fully manifested in the history of the various arts and sciences. In every department the first, the leading, minds have belonged to the male sex. Homer, Shakespeare, Phidias, Beethoven, no less than Newton, Liebig, and Darwin, are men.

In reply to this historical confirmation of what biology foretells, the advocates of the movement adduce three arguments, all, in our opinion, singularly inconclusive.

Admitting the superiority of the male brain in bulk and weight to that of the female, they maintain the existence of a qualitative difference which renders the two incommensurable. This hypothesis, however, is a pure assumption. We should have an equal right to maintain that the brains of different races of men, especially as existing in ages widely remote from each other, were incapable of mutual comparison. Or, in the same spirit, it might even be urged that the smaller size of the muscles in woman was no proof of any inferiority in physical strength.

Secondly, it is contended by those who seek to identify the duties, functions, and spheres of action of the two sexes, that many women have distinguished themselves in the arts and sciences. Admitting to the full this fact, we can only place it on a level with the kindred phenomenon that not a few women have, in disguise, entered the army or navy, and have acquitted themselves as creditably as their male comrades; or that others have worked long and undetected as excavators, in the construction of railways, etc. The *savante*—the woman of science—like the female athlete, is simply an anomaly, an exceptional being, holding a position more or less intermediate between the two sexes. In the one case the brain, as in the other the muscular system, has undergone an abnormal development. That such cases should occur need no more surprise us than does the converse phenomenon, the existence of womanish man. We meet with subjects, otherwise of the male sex, in whom the beard is scanty or wanting, the limbs slight and rounded, the voice high, the chest narrow, and the pelvis broad, or who, if they do not structurally approximate to the female sex, betray a preference for feminine occupations, which wins for them such epithets as "molly-cots," "cot-queans," etc. At the risk of somewhat anticipating ourselves we cannot suppress the remark that no one demands especial laws and institutions for the benefit of such womanish men, or proposes their exemption from the customary duties of the male sex, how burdensome soever these may be felt.

The third and last plea put forward to explain, if possible, the cerebral inferiority of woman and her concomitant intellectual inferiority,

is an adaptation of the one already proposed to account for her smaller physical strength. It is gravely asserted that mental activity in art or science has been systematically repressed among women, and that in consequence their cerebral development has been injuriously interfered with. To this contention it would be a sufficient reply were we to simply point to the fact already mentioned, that the relative inferiority in the size of the brain of women, instead of diminishing as their social status has improved, has, on the contrary, been increasing. We may hence fairly argue that it exists not in virtue of any artificial interference, but of a law of Nature. We can, however, adduce other considerations. In the pursuit of the fine arts, woman, instead of being checked and hindered, whether by law or by social conventions, has been encouraged. An acquaintance with music has been literally forced upon every girl of the upper and middle classes. Yet, leaving composers out of the question, how many of the million female performers on the piano-forte, now to be found in Europe and America, can take rank with Liszt and Thalberg? In the highest development of literature, poetry, sex has been no obstacle to the recognition of merit. Yet neither Sappho in the past nor Mrs. Hemans and Mrs. Browning in our own day can be placed even in the same class with the leading poets of Greece, England, and Germany.

Women have certainly till of late met with few direct facilities for the pursuit of science. But, in England at least, neither have men. Our great scientific discoverers, until quite recent days, have been substantially self-taught, and even if in their youth they enjoyed a university education their subsequent researches, though *post hoc* (after this), have assuredly not been *propter hoc* (on account of this). Scientific books and apparatus have been as accessible to one sex as to the other; and these have generally been the only opportunities that our discoverers have had at their command. How to use such appliances they had to discover for themselves. We deny, therefore, that the exclusion of young women from universities, *in which modern sciences were not taught*, can have hindered them from entering upon a scientific career. Equally do we deny that public opinion forbade for them study and research. Had Miss Herschel been a man, her astronomical discoveries could not have been more highly or more deservedly appreciated. Not a dog barked at her for preferring determining the orbits of comets to ordinary feminine avocations. In like manner, if any woman had possessed the necessary faculties and turn of mind, there was nothing in the way of public prejudices or established customs to prevent her from having anticipated Dalton in discovering the laws of definite chemical combination. Nor, if thus discovered, would the "atomic theory" have met with a less favorable reception. We then entirely deny the existence of any supposed conspiracy to repress scientific talent in the female sex, and we hold that the three arguments adduced to explain its comparative rarity among women are utterly inconclusive.

A further distinction between the sexes, common to mankind and to all the mammalian class, must be sought in the moral faculties. Take what species we like we find the males bolder, more pugnacious and quarrelsome, more adventurous and restless, and less tractable and docile. The females, on the other hand, save in protection of their young from real or supposed danger, are mild, gentle, and inoffensive. Of this no more indisputable instance could be found than the case of domestic cattle, the cow—with the exception of certain "strong-minded" individuals—being perfectly harmless, while the bull, when above four years old, is one of the most dangerous animals known, attacking and killing human beings, not for food, like the lion or the tiger, but out of pure "superfluity of naughtiness." Very similar is the distinction between the character of the sexes among the Quadrumana. No animal is more wantonly and gratuitously mischievous than an adult male baboon, and we are unable to find an instance of one having been tamed so far that he could be allowed his liberty. The females, on the other hand, are capable of domestication. Were there any necessity to multiply instances a fair-sized volume might be filled with accounts of the intractability of male mammalia of different species, as contrasted with the mildness and docility of their females, while in no animal is the case reversed. That the sexual distinction of character in our own species is precisely analogous in its nature will, we trust, be admitted without argument.

We find, therefore, summing up the foregoing facts, that throughout the mammalian community the males are larger and heavier than the females, whom they, moreover, especially exceed in thoracic and cerebral development; that they are consequently stronger, more intensely animated, and in disposition bolder and fiercer. The very same differences are found in average men as compared with average women, with the additional peculiarity that here the superior size of brain expresses itself in higher intellectual power.

It would be ridiculous to suppose that all these diversities, structural and functional, are objectless, and do not imply a corresponding diversity of duties. This accordingly we find to be the case: The male, at least in all species which form unions of any degree of permanence—whether monogamous or polygamous—defends and protects the female and her young ones. Thus, if a herd of elephants is menaced, the most powerful tuskers take their station on the side where danger appears, while the females and the young are placed as far as possible out of harm's way. If bisons are attacked by wolves, the bulls form a circle inclosing the cows and calves. A similar order is adopted by wild-horses. A gorilla will encounter any danger in defense of his mate, and even among baboons the old males will face an approaching enemy while the weaker members of the troop make good their escape. A lion has been seen in the same manner covering the retreat of his lioness and her cubs.

Other examples might be given were it at all needful, but those already stated are surely sufficient to establish the principle. Among herbivorous and omnivorous species, where food is plentiful, there is no occasion for the male to take upon him the duties of provider, but among the Carnivora he frequently supports as well as defends his family. The lion is in this respect a well-known instance.

We find, therefore, that throughout the class Mammalia the respective tasks of the two sexes are precisely such as we find in our own species: the male is the defender and provider, wherever such defense and provision are necessary; the female is the nurse. The man who brings home to his wife his weekly earnings, his professional fees, or his share of the profits of a business, merely repeats on a higher scale the action of the lion who carries a deer or an antelope to his den. Each sex fulfills the tasks for which it is especially adapted by Nature, and anything like "subjugation" is utterly out of the question. Were the duties of the two sexes confounded together, or, still more, were they inverted—the female, for instance, going forth to face danger or to hunt for prey, while the male was left to nurse the young—the position of the species in the great and constant struggle for existence would be very decidedly altered for the worse. We must conclude, therefore, that the attempt to alter the present relations of the sexes is not a rebellion against some arbitrary law instituted by a despot or a majority—not an attempt to break the yoke of a mere convention; it is a struggle against Nature; a war undertaken to reverse the very conditions under which not man alone, but all mammalian species have reached their present development. Sentimental speakers and writers have commented on the well-known fact that even a very young boy will, to his utmost ability, defend his sister or female playmate, and have expressed a hope that this habit—the result of early training—would wear out, the female no longer needing and the male no longer offering protection. Alas! is the very same habit in the ape, the lion, or the bison, the result of a mistaken training, or of an old-world convention, to be laid aside in these enlightened days? What would be the position of a family of young lions if both their parents went forth to hunt? Yet very similar will be that of children if their mother, as well as their father, goes out to the daily toils of a profession, leaving them perhaps to themselves—perhaps to the care of ignorant and unprincipled hirelings. The results of mothers withdrawn from domestic duties, and spending their days in industrial pursuits, have been sufficiently exemplified in our manufacturing towns. Here, in the very highest interests of the race, it has been found necessary to check and limit female labor, which ought never to have been introduced. Had this precaution been taken, a man would have been able to earn as much as he and his wife jointly have been able to realize under the factory system. But what reason have we to expect that the introduction of female labor into professional spheres will prove a

greater boon either to the aspirants themselves or to the nation than it has been in the factory and the workshop? A friend, of original habits of thought, points out[1] that upon man alone was laid the penalty of labor as upon woman the sorrow of child-bearing. This is in fact the very same lesson, clothed in theological language, which we learn from biology. Among the lower animals, who, as compared with man, may be called the proletariate[2] of creation, both sexes indeed seem merely or mainly to exist in order to perpetuate their species. Still, even here, the female is more exclusively constructed for, and more totally absorbed in, the task of reproduction than the male. The share of the latter in this function is, strictly speaking, momentary, while during the stage of maturity the energies of the normal female are more or less completely devoted to the nurture, intra- and extra-uterine, of her offspring. Even when she never becomes a mother the generative system exercises a modifying influence upon her whole career. This consideration throws a strong light upon the ground taken by certain of the more "advanced" female advocates of the movement. The *femme libre* (free woman) of the new social order may, indeed, escape the charge of neglecting her family and her household by contending that it is "not her vocation to become a wife and a mother." Why then, we ask, is she constituted a woman at all? Merely that she should become a sort of second-rate man? We have already declared, and we repeat, that we wish a free career for every talent. If an abnormal woman possesses a man's muscular strength and adaptation for toil, we would not, either by law or by social influences, seek to debar her from working at the oar, or the forge, or even from wielding the policeman's truncheon or the soldier's rifle. But we would not calculate on such anomalies; we would not legislate for their special protection, or seek to increase their number. In a manner perfectly analogous, if a woman possesses the taste and the power for scientific research usually confined to men—and far from common even among them—we would not wish to restrain her from the cultivation of her peculiar faculties; but we would not foster the growth of such a class of females. We would not seek to entice women into the observatory, the laboratory, or, above all, into the dissecting-room, nor erect colleges for the training of *savantes*, any more than we would organize female regiments and open institutions where muscular young ladies might perfect themselves in the management of heavy artillery.

It is generally—too generally—assumed that every novelty, every change from what has hitherto been customary and recognized, commends itself, on the mere ground of its novelty, to men of science, as, indeed, to all unfettered inquirers, and will be resisted merely by those

[1] Genesis iii. 16, 17.

[2] As applied to the human species we consider this term eminently foolish. The man who benefits his race in no other way will probably injure it by leaving posterity like himself.

whose guiding principle is an unreasoning attachment to what is established. Never, perhaps, was it shown more clearly than with reference to the present question that innovation may be retrograde—that a proposed change, if carried out, may involve a return to a lower stage of development. What is the very essence of all advance to a higher stage of being, save differentiation? We see what was at first homogeneous, uniform in structure, become resolved into distinct tissues and members. We see functions which, in some rudimentary state, were jointly exercised by the whole body of an animal, gradually allotted out to special organs, and, during and in consequence of this very specialization, acquiring a far higher degree of perfection than they heretofore possessed. Look at the first rudimentary state—germ, seed, or ovum—of the plant or animal, and compare it with the mature organism to which it ultimately gives rise. What was one has become manifold; what was simple is now highly complex. The globule of albuminoid matter has developed into distinct members—sense-apparatus, organs respiratory, digestive, circulatory, locomotive, etc.—each of which has a separate task to fulfill, and is distinctly organized for that very purpose. It is no departure from our subject to remark that, though in the organic body one organ may, under certain circumstances, undertake the duties of another, such vicarious action involves grave peril to the organ concerned, and to the entire animal. Perhaps the world may yet find that the analogy between the individual and mankind holds good in this respect, and that a social congestion may follow from the movement we are examining.

To return: the increase of size which distinguishes the butterfly from the egg, or the oak from the acorn, is a trifling feature compared with the accompanying differentiation—chemical, morphological, and functional—which has taken place.

If we pass from a consideration of the individual plant or animal to a survey of the entire organic realms, we find, as we advance from the humblest and meanest beings to the highest, merely a repetition of the same great fact. At the one extremity of the scale—if this expression may still be used—we find beings whose senses, such as they are, must be exercised by the whole external surface of the body, those more special functions which we know as sight, hearing, etc., being still identical with feeling. No distinct nervous system, still less definite nerve-centres, can be traced. Nor are there any organs specially devoted to the processes of respiration, circulation, digestion, etc. A common internal cavity takes the place, and, in a crude way, fulfills the duties of all these parts. Externally the same uniformity prevails; there are no limbs, no members exclusively constructed for locomotion in any of its modes, or for prehension. The animal moves by elongating and contracting its whole body, or by rolling over. In many of the lower forms of animal life the sexes are not separated, the functions of the male and the female being exercised by one and the same individual.

It is a fact, long familiar to the world, that the polyp may be cut into without injury, each part soon becoming a complete animal.

To such simplicity of structure the completest contrast is afforded by the higher animals. Throughout their bodies we find a "division of labor," each function having its organ and each organ its distinct function. To trace how this differentiation is carried out would be wearisome, and, being admitted, is fortunately needless.

It may be useful, however, to call to mind the fact that animals which, when mature, are broadly and easily distinguished from each other, are more and more alike the earlier the stage of growth at which we institute a comparison. The differences between a baby chimpanzee and a human infant are much slighter than those between the adults of the respective species. If we extend our researches to the embryonic state we find that the rudimentary man can scarcely be distinguished from many of the other vertebrates. It is only, as Prof. Huxley points out, in the later stages of prenatal growth that the human fœtus differs from that of an ape. In the former the convolutions of the brain, according to Prof. Bischoff, reach about the same stage of development as in an adult baboon. The great toe, in man, is considered by Prof. Owen the most characteristic feature of the human skeleton; but, in an embryo about an inch in length, Prof. Wyman found this member not lying parallel with the other toes, but projecting out from the side of the foot as it does permanently in the so-called Quadrumana in their mature condition. Thus plainly does it appear that differentiation is the way to perfection, each animal as it approaches maturity diverging more and more from other forms, from which, in its earlier stages, it was scarcely distinguishable.

Yet again, we may turn from a survey of the growth of the individual, and from a comparison of the highest and lowest forms of contemporary organic life, to the consideration of the successive phases of being that have peopled our earth. Here, too, we find the same great law prevail. In the remote past we find what are called "generalized forms"—animals which seem to have combined in themselves the rough outlines of what we now find developed into perfectly distinct beings.

Suppose it were now proposed as an improvement in the structure of man, or of any other mammalian species, that the functions now exercised by two distinct organs—such as, e. g., the eye and the ear, or the nerves of motion and of sensation—should be "lumped" together, committed to one only set of organs; would such a change, if we for the moment suppose it practicable, be an advance or a retreat? Would it raise or lower the species in the scale of existence? It might seem a convenience if, instead of seeing with our eyes alone, we could also see and hear with our ears; but would either the seeing or the hearing be done as well as now, when each is the sole function of an express organ? On the principles of the old natural history, as well as of the

new, we may safely reply in the negative. The change we have supposed is fortunately incapable of being effected, otherwise the attempt would doubtless be made in the name of "progress."

But we may follow the principle of differentiation, and trace its workings over the boundaries of biology into those of sociology, if such a science can be said to exist. Where differences of structure can no longer be traced we still find differences of function. In man we find no variation in the number and position of bodily organs; yet identical organs in different individuals are trained to special tasks which to other men would be impossible, and which might seem to necessitate a structural difference. We come, that is to say, upon the division of labor, which is one of the most characteristic and essential features of civilization. We have seen that in the lowest forms of animal life the entire body seemed to subserve every vital process; just so in the lowest stages of human society, every individual is at once warrior, hunter, builder, maker of arms and other utensils, and—in as far as agriculture is practised at all—tiller of the soil. Every man is perforce, in the words of the adage, "Jack of all trades," with the inevitable consequence that he is "master of none." In a civilized nation, just as in the higher animals, all this is reversed. Every function has its special organ, or, in other words, every task is committed to a separate man or body of men. In all this we can trace out nothing that speaks of arbitrary interference or compulsion. In the animal or human body each function is committed to organs fitted for that function. The stomach does not protest because it is not the seat of respiration, nor does the heart crave to undertake the task of digestion, either instead of or along with its own duties. In human society—complain as we may about "square pegs" being placed in "round holes"—the different tasks are in the main assigned to the men most competent for their performance. In a savage tribe the strongest and bravest naturally leads in war; the man keenest of eye and ear becomes the scout, either as regards hostile tribes or beasts of the chase. The wisest and most eloquent—attributes which, if necessarily connected in primitive times, are now so no longer—took the foremost place in council. The man of greatest manual dexterity would be chief bow-maker to the tribe. The process in operation was, in fact, natural selection. The man who undertook a task for which he was unfitted, or less fitted than others, was gradually eliminated, as far as that particular task was concerned. In proportion as new wants sprung up and new means of gratifying them were devised, social functions were multiplied, and the division of labor became more minute. Yet even in the very rudest state, as far at least as anthropologists have been able to trace, there never was a time when the duties of all persons were absolutely identical. To men and to women different duties were assigned on the same principle of natural selection. Changes have, indeed, taken place in the distribution of the tasks respectively allotted to the two sexes. But these changes,

it is important to note, till the "woman's-rights' movement" sprung up, have all been in one direction—the direction of increasing differentiation. The distinction between men's work and women's work has been increased, not diminished. The barbarian and the semi-civilized nation allowed women to carry heavy burdens, to tug at the oar, to wield the spade, the hoe, the mattock, in the fields, and even to labor in mines. In our higher civilization such tasks are limited to man, and, as we have already remarked, to abnormal "mannish" women. The movement we are considering, in so far as it aims at breaking down the natural barriers between the duties of the two sexes, is palpably retrograde. If advancement toward perfection is reached by differentiation, *anti-differentiation*—if we may use the expression—whether structural or functional, must be a return to a lower condition. If the first and plainest step in the division of labor is to be abandoned, how can others be maintained?

It has been already pointed out in the *Quarterly Journal of Science* that among vertebrate animals the social unit of which nations are put together is the family, whether that be monogamous or polygamous. A community of rooks is made up of an assemblage of married couples. A tribe of baboons consists of a number of males, each one having his wives and offspring. Now the "woman's-rights' movement" not merely runs counter to Nature in the respects we have already shown, but it is open to the charge of seeking to destroy family life and to constitute society of individuals—of atoms instead of molecules. In so doing it tends toward the condition of things prevalent in certain insect-communities. But there the mass of the nation, and especially its working and fighting members, is composed of what are commonly called neuters. Of such an arrangement no trace prevails among vertebrate animals, and we do not therefore see how their example can afford us any practical precedent.

We have, therefore, in fine, full ground for maintaining that the "woman's-rights' movement" is an attempt to rear, by a process of "unnatural selection," a race of monstrosities—hostile alike to men, to normal women, to human society, and to the future development of our race. We know that the modern "honorary secretary" is always ready to exclaim, "Let heaven and earth perish, so my crotchet may be realized!" But we would bid him ask himself whether the end is worth the means.—*Quarterly Journal of Science.*

ANIMAL INTELLIGENCE.[1]

By GEORGE J. ROMANES.

ANIMAL INTELLIGENCE is a subject which has always been of considerable interest to philosophical minds; but, as most of you are probably aware, the interest attaching to this subject has of late years been greatly increased by the significance which it has acquired in relation to the theory of descent. The study of animal intelligence being thus, without question, fraught with high importance to the science of our time, in adducing before this illustrious assembly some of the results which that study has yielded, I shall endeavor to treat them in a manner purely scientific. I shall try, as much as possible, to avoid mere anecdote, except in so far as it is desirable that I should put you in possession of a few typical facts to illustrate the various principles which I shall have occasion to expound. I shall seek to render apparent the more important of the issues which the subject, as a whole, involves, as well as the considerations by which alone these issues can be legitimately settled. I shall attempt to state my own views with the utmost candor; and if I shall appear to ignore any arguments opposed to the conclusions at which I shall arrive, it will only be because I believe those arguments to admit of easy refutation. And, in order that my exposition may be sufficiently comprehensive, I shall endeavor to point out the relations that subsist between the intelligence of animals and the intelligence of man. The aim and scope of the present lecture will therefore be to discuss, as fully as time permits, the facts and the principles of Comparative Psychology.

As human intelligence is the only order of intelligence with which we are directly acquainted, and as it is, moreover, the highest order of intelligence known to science, we may most conveniently adopt it as our standard of comparison. I shall therefore begin by very briefly detailing those principles of human psychology which we shall afterward find to be of the most essential importance in their bearings on the subject which I have undertaken to discuss.

When I allow my eyes to travel over this vast assembly, my mind receives, through their instrumentality, a countless number of impressions. So far as these impressions enter into the general stream of my consciousness, they constitute what are called perceptions. Suppose, now, that I were to close my eyes, and to fix my attention on the memory of some particular perception which I had just experienced —say the memory of some particular face. This mental image of a previous perception would be what is called an idea. Lastly, suppose that I were to analyze a number of the faces which I had perceived, I

[1] An evening lecture delivered before the British Association at Dublin, August 16, 1878.

should find that, although no two of them are exactly alike, they all bear a certain general resemblance to one another. Thus from the multitude of faces which I now perceive it becomes possible for my mind to abstract from them all the essential qualities of a face as a face; and such a mental abstraction of qualities would then constitute what I might call my abstract idea of a face in general, as distinguished from my concrete idea, or memory, of any face in particular.

Thus, then, we have three stages: 1. That of immediate perception; 2. That of ideal representation of particular objects; and, 3. That of a generalized conception, or abstract idea, of a number of qualities which a whole class of objects agree in possessing. It will be convenient to split the latter division into two subdivisions, viz., abstract ideas which are sufficiently simple to be developed without the aid of language, and abstract ideas which are so complex as not to admit of development without the aid of language. As an instance of the former class of abstract ideas we may take the idea of food. This is aroused in our minds by the feeling of hunger; and, while the idea when thus aroused is clearly quite independent of language, it is no less clearly what is called an abstract idea. For it is by no means necessary that the idea of food which is present to the mind should be the idea of some special kind of food; on the contrary, the idea is usually that of food in *general*, and this idea it is which usually prompts us to seek for any kind of food in *particular*. Simple abstract ideas, therefore, may be formed without the assistance of language; and for this reason they are comprised within what has been called the Logic of Feelings. But abstract ideas of a more elaborated type can only be formed by the help of words, and are therefore comprised within what has been called the Logic of Signs. The manner in which language thus operates in the formation of highly-abstract ideas is easily explained. Because we see that a great many objects present a certain quality in common, such as redness, we find it convenient to give this quality a name; and having done this we speak of redness in the abstract, or as standing apart from any particular object. Our word "redness" then serves as a sign or symbol of a quality as apart from any particular object of which it may happen to be a quality; and having made this symbolical abstraction in the case of a simple quality, such as redness, we can afterward compound it with other symbolical abstractions, and so on till we arrive at verbal symbols of more and more complex qualities, as well as qualities further and further removed from immediate perception. By the help of these symbols, therefore, we climb into higher and higher regions of abstraction; by thinking in verbal signs, we think, as it were, with the semblance of thoughts, and by combining these signs in various ways, and giving the resulting compounds distinctive names, we are able to condense into single words, or signs, an enormous amount of meaning. So that, just as in mathematics the symbols which are employed contain, in an easily

manipulated form, the whole meaning of a long calculation, so in all other kinds of reasoning the symbols which we call words contain, in an abbreviated form, vast bodies of signification. Indeed, any one who investigates this subject cannot fail to become convinced that it is wholly impossible to over-estimate the value of language as thus the handmaid of thought; for, as we have seen, in the absence of language it would be impossible for thought to rise above the very simplest of abstract ideas, while in the presence of language it becomes possible for us consciously to predicate qualities, and so at last to feel that we are conscious of our own consciousness.

So much, then, for our classification of ideas. We have, first, simple ideas, or ideas of particular perceptions; and, secondly, abstract ideas, or ideas of general qualities; and the latter class I have subdivided into those which may be developed by simple feelings, and those which can only be developed by the aid of signs.

Now, with regard to ideas themselves, I need only add that they are the psychological units which compose the whole structure intellectual. They constitute, as it were, the raw material of thought, which may be elaborated by the reflective faculty into various products of thought. Once formed they present an essential property of occurring in concatenated series; so that the occurrence of one idea determines that of another with which it has been previously joined. This principle of the association of ideas, manifested as it is by the ultimate units of intellectual structure, is by far the most important principle in psychology: it is the principle which renders possible all the faculties of mind — memory, instinct, judgment, reason, emotion, conscience, and volition.

We are now in a position to investigate the facts of comparative psychology; and, in order to do so thoroughly, I shall begin by considering what I may term the physiological basis of mind. There is no reasonable doubt that all mental processes are accompanied by nervous processes; or, to adopt the convenient terms of Prof. Huxley, that psychosis is invariably associated with neurosis. The nature of this association, according to the best lights of our present knowledge, is probably as follows: Nerve-tissue consists of two elementary parts, viz., nerve-cells and nerve-fibres. The nerve-cells are usually collected into aggregates, which are called nerve-centres, and to these nerve-centres bundles of nerve-fibres come and go. The incoming nerve-fibres serve to conduct stimuli or impressions to the cells in the nerve-centre; and, when the cells thus receive a stimulus or impression, they liberate a discharge of nervous energy, which then courses down the outgoing nerve-fibres to be distributed either to other nerve-centres or else to muscles. It is in this way that nerve-centres are able to act in harmony with one another, and so to coördinate the action of the muscles over which they preside. This fundamental principle of neurosis is what physiologists call the principle of reflex action; and you will per-

ceive that all it requires for its manifestation is an incoming nerve, a nerve-centre, and an outgoing nerve, which together constitute what has been called a nervous arc. Now, there can be no reasonable doubt that in the complex structure of the brain one nervous arc is connected with another nervous arc, and this with another almost *ad infinitum;* and there can be equally little doubt that processes of thought are accompanied by nervous discharges taking place now in this arc and now in that one, according as the nerve-centre in each arc is excited to discharge its influence by receiving a discharge from some of the other nerve-arcs with which it is connected. Again, it is almost certain that the more frequently a nervous discharge takes place through a given group of nervous arcs, the more easy will it be for subsequent discharges to take place along the same routes—these routes having been thus rendered more permeable to the passage of subsequent discharges. So that in this physiological principle of reflex action we no doubt have the objective side of the psychological principle of the association of ideas. For it may be granted that a series of discharges taking place through the same group of nervous arcs will always be attended with the same occurrence of the same series of ideas; and it may be further granted that the previous passage of a series of discharges through any group of nervous arcs, by making the route more permeable, will have the effect of making subsequent discharges pursue the same course when started from the same origin. And, if these two propositions be granted, it follows that the tendency of ideas to *recur* in the same order as that in which they have previously *occurred* is merely a psychological expression of the physiological fact that lines of reflex discharge become more and more permeable by use. We thus see that the most fundamental of psychological principles—the association of ideas—is merely an obverse expression of the most fundamental neurological principles —reflex action. But here we have an important qualification to take into account. All reflex action, or neurosis, is not attended with ideation, or psychosis. In our own organization, for instance, it is only cerebral reflexes which are so attended; and even among cerebral reflexes there is good reason to believe that the greater number of them are not accompanied by conscious ideation; for analysis shows that it is only those cerebral discharges which have taken place comparatively seldom, and the passage of which is therefore comparatively slow, that are accompanied by any ideas, or changes of consciousness. The more habitual any action becomes, the less conscious do we require to be of its performance; it is, as we say, performed automatically, or without thought. Now, it is of great importance thus to observe that consciousness only emerges when cerebral reflexes are flowing along comparatively unaccustomed channels, and therefore that cerebral discharges which at first were accompanied by definite ideas may, by frequent repetition, cease to be accompanied by any ideas. It is of importance to observe this fact, because it serves to explain the origin of a number

of animal instincts. These instincts must originally have been of an intelligent nature; but the actions which they prompted, having through successive generations been frequently repeated, became at last organized into a purely mechanical reflex, and therefore now appear as actions which we call purely automatic or blindly instinctive. Thus, for instance, the scratching of graminivorous birds in earth and stones was no doubt originally an intelligent action, performed with the conscious purpose of uncovering seeds; but by frequent repetition through successive generations the action has now become blindly instinctive. This is shown by the following experiment: Dr. Allen Thomson tells me that he hatched out some chickens on a carpet, where he kept them for several days. They showed no inclination to scratch, because the stimulus supplied by the carpet to the soles of their feet was of too novel a character to call into action the hereditary instinct; but when Dr. Thomson sprinkled a little gravel on the carpet, and so supplied the appropriate or customary stimulus, the chickens immediately began their scratching movements. Yet, for aught that these chickens can have known to the contrary, there was as good a chance of finding seeds in the carpet as in the thin layer of gravel. And numberless other cases might be given to prove that animals acquire instincts by frequently repeating intelligent actions, just as we ourselves acquire, even in our individual lifetime, an instinct to adjust our nightcaps—an instinct which may become so pronounced as to assert itself even when a man is in the profound unconsciousness of apoplectic coma.

Thus we are able to explain all the more complicated among animal instincts as cases of "lapsed intelligence." But, on the other hand, a great many of the more simple instincts were probably evolved in a more simple way. That is to say, they have probably never been of an intelligent character, but have begun as merely accidental adjustments of the organism to its surroundings, and have then been laid hold upon by natural selection and developed into automatic reflexes. Take, for instance, the action of so-called "shamming dead," which is performed by certain insects and allied animals when in the presence of danger. That this is not a case of intelligent action we may feel quite sure, not only because it would be absurd to suppose that insects could have any such highly-abstract ideas as those of death and its conscious simulation, but also because Mr. Darwin tells me that he once made a number of observations on this subject, and in no case did he find that the attitude in which the animal shammed dead resembled that in which the animal really died. All, therefore, that "shamming dead" amounts to is an instinct to remain motionless, and therefore inconspicuous, in the presence of enemies; and it is easy to see that this instinct may have been developed by natural selection without ever having been of an intelligent nature—those individuals which were least inclined to run away from enemies being preserved rather than those which rendered themselves conspicuous by movement.

So that we thus see how animal instincts may arise in either of two different ways: for, on the one hand, they may arise from the performance of actions which were originally intelligent, but which by frequent repetition have become automatic; and, on the other hand, they may arise from survival of the fittest, preserving actions which, although never intelligent, yet happen to have been of benefit to the animals which first chanced to perform them. But now let it be observed that, although there is a great difference between these two kinds of instincts if regarded psychologically, there is no difference between them if regarded physiologically; for, regarded physiologically, both kinds of instincts are merely expressions of the fact that particular nerve-cells and fibres have been set apart to perform their reflexes automatically—that is, without being accompanied by intelligence.

So much, then, for what I have called the physiological basis of mind; and, in now taking leave of this part of my subject, I should like to point out that, in recognizing the indisputable fact of mind having such a basis, we are not necessarily committing ourselves to the doctrine of materialism. That psychical phenomena are very intimately associated with physical phenomena is a fact which does not admit of one moment's dispute; but concerning the nature of this association Science must declare, not merely that it is at present unknown, but that, so far as she is at present able to discern, it must forever remain unknowable. The restless tide of intellect for centuries has onward rolled, submerging in its every arm those strong and rugged shores whose name is Why; but at the line where mind and matter meet there rises, like a frowning cliff, a mighty mystery, and in the darkness of the place we hear the voice of true Philosophy proclaim, "Hitherto shalt thou come, but no farther, and here shall thy proud waves be stayed."

Passing on now to our review of comparative psychology, the first animals in which, so far as I can ascertain, we may be quite sure that reflex action is accompanied by ideation, are the insects. For Mr. Darwin has observed that bees remember the position of flowers which they have *only several times* visited, even though the flowers be concealed by intervening houses, etc. Sir John Lubbock also has shown that, *after a very few individual experiences*, bees are able to establish a definite association between particular colors on paper and food; and further that, *after a very few lessons*, a bee may be taught to find its way out of a glass jar. These observations would seem to prove that the grade of intelligence is higher in some Articulata than it is among the lower Vertebrata. For many of you will probably remember the experiment of Prof. Möbius, which proved that a pike requires three months to establish an association of ideas between particular kinds of prey and the fact of their being protected by an invisible wall. This fact was proved by the pike repeatedly dashing its nose against a glass partition in its tank in fruitless efforts to catch minnows which were

confined on the other side of the partition. At the end of three months, however, the requisite association was established, and the pike, having learned that its efforts were of no use, ceased to continue them. The sheet of glass was then removed; but the now firmly-established association of ideas never seems to have become disestablished, for the pike never afterward attacked the minnows, though it fed voraciously on all other kinds of fish. From which we see that a pike is very slow in forming his ideas, and no less slow in again unforming them—thus resembling many respectable members of a higher community, who spend one half of their lives in assimilating the obsolete ideas of their forefathers, and through the other half of their lives stick to these ideas as to the only possible truths; they can never learn when the hand of Science has removed a glass partition.

As regards the association of ideas by the higher vertebrated animals, it is only necessary to say that in all these animals, as in ourselves, this principle of association is the fundamental principle of their psychology; that in the more intelligent animals, associations are quickly formed, and when once formed are very persistent; and, in general, that, so far as animal ideation goes, the laws to which it is subject are identical with those under which our own ideation is performed.

Let us, then, next ask, "How far does animal ideation go?" The answer is most simple, although it is usually given in most erroneous form. It is usually said that animals do not possess the faculty of abstraction, and therefore that the distinction between animal intelligence and human intelligence consists in this—that animals are not able to form abstract ideas. But this statement is most erroneous. You will remember the distinction which I previously laid down between abstract ideas that may be developed by simple feelings, such as hunger, and abstract ideas that can only be developed by the aid of language. Well, remembering this distinction, we shall find that the only difference between animal intelligence and human intelligence consists in this—that animal intelligence is unable to elaborate that class of abstract ideas the formation of which depends on the faculty of speech. In other words, animals are quite as able to form abstract ideas as we are, if under abstract ideas we include general ideas of qualities which are so far simple as not to require to be fixed in our thoughts by names. For instance, if I see a fox prowling about a farm-yard, I cannot doubt that he has been led by hunger to visit a place where he has a general idea that a number of good things are to be fallen in with, just as I myself am led by a similar impulse to visit a restaurant. And, to take only one other instance, there can be no question that animals have a generalized conception of cause and effect. For example, I had a setter dog which was greatly afraid of thunder. One day a number of apples were being shot upon the wooden floor of an apple-room, and as each bag of apples was shot it produced through the rest of the house

a noise resembling that of distant thunder. My dog became terror-stricken at the sound; but, as soon as I brought him to the apple-room and showed him the true *cause* of the noise, he became again buoyant and cheerful as usual. Another dog I had used to play at tossing dry bones to give them the appearance of life. As an experiment, I one day attached a fine thread to a dry bone before giving him the latter to play with; and, after he had tossed the bone about for a while as usual, I stood a long way off and slowly began to draw it away from him. So soon as he perceived that the bone was really moving on its own account, his whole demeanor changed, and rushing under a sofa he waited horror-stricken to watch the uncanny spectacle of a dry bone coming to life. I have also greatly frightened this dog by blowing soap-bubbles along the floor; one of these he summoned courage enough to touch with his paw, but as soon as it vanished he ran out of the room, terrified at so mysterious a disappearance. Lastly, I have put this dog into a paroxysm of fear by taking him into a room alone and silently making a series of horrible grimaces. Although I had never in my life hurt this dog, he became greatly frightened at my unusual behavior, which so seriously conflicted with his general idea of uniformity in matters psychological. But I have tried this experiment with less intelligent dogs without any other result than that of causing them to bark at me.

Of course in thus claiming for animals the power of forming general conceptions, I mean only such general conceptions as can be arrived at by the logic of feelings. So far, then, as the logic of feelings can carry them, I maintain that the intellectual operations of animals are indistinguishable from those of ourselves. For having thus shown that animals possess the faculty of abstraction, I shall now go on to show that they possess the faculties both of judgment and of reason. My friend Dr. Rae, the well-known traveler and naturalist, knew a dog in Orkney which used to accompany his master to church on alternate Sundays. To do so he had to swim a channel about a mile wide; and before taking to the water he used to run about a mile to the north when the tide was flowing, and a nearly equal distance to the south when the tide was ebbing, "almost invariably calculating his distance so well that he landed at the nearest point to the church." In his letter to me Dr. Rae continues: "How the dog managed to calculate the strength of the spring and neap tides at their various rates of speed, and always to swim at the proper angle, is most surprising."

So much, then, for judgment. For some good instances of reasoning in animals I am also indebted to Dr. Rae. Desiring to obtain some arctic foxes, he set various kinds of traps; but, as the foxes knew these traps from previous experience, he was unsuccessful. Accordingly, he set a kind of trap with which the foxes in that part of the country were not acquainted. This consisted of a loaded gun set upon a stand pointing at the bait. A string connected the trigger of the

gun with the bait, so that when the fox seized the bait he discharged the gun, and thus committed suicide. In this arrangement the gun was separated from the bait by a distance of about twenty yards, and the string which connected the trigger with the bait was concealed throughout nearly its whole distance in the snow. The gun-trap thus set was successful in killing one fox, but not in killing a second; for the foxes afterward adopted either of two devices whereby to secure the bait without injuring themselves. One of these devices was to bite through the string at its exposed part near the trigger, and the other device was to burrow up to the bait through the snow at right angles to the line of fire, so that, although in this way they discharged the gun, they escaped without injury—the bait being pulled below the line of fire before the string was drawn sufficiently tight to discharge the gun. Now, both of these devices exhibited a wonderful degree of what I think must fairly be called power of reasoning. I have carefully interrogated Dr. Rae on all the circumstances of the case, and he tells me that in that part of the world traps are never set with strings, so that there can have been no special association in the foxes' minds between strings and traps. Moreover, after the death of fox number one, the track on the snow showed that fox number two, notwithstanding the temptation offered by the bait, had expended a great deal of scientific observation on the gun before he undertook to sever the cord. Lastly, with regard to burrowing at right angles to the line of fire, Dr. Rae and a friend in whom he has confidence observed the fact a sufficient number of times to satisfy themselves that the direction of the burrowing was really to be attributed to thought and not to chance.

I could give several other unequivocal instances of reasoning on the part of animals which I have myself observed; but time does not permit of my stating them. Passing on, therefore, to the emotional life of animals, we find that this is very slightly, if at all, developed in the lower orders, but remarkably well developed in the higher; that is to say, the emotions are vivid and easily excited, although they are shallow and evanescent. They thus differ from those of most civilized men in being more readily aroused and more impetuous while they last, though leaving behind them but little trace of their occurrence. As regards the particular emotions which occur among the higher animals, I can affirm from my own observations that all the following give unmistakable tokens of their presence: Fear, Affection, Passionateness, Pugnacity, Jealousy, Sympathy, Pride, Reverence, Emulation, Shame, Hate, Curiosity, Revenge, Cruelty, Emotion of the Ludicrous, and Emotion of the Beautiful. Now, this list includes nearly all the human emotions, except those which refer to religion and to the perception of the sublime. These, of course, are necessarily absent in animals, because they depend upon ideas of too abstract a nature to be reached by the mind when unaided by the logic of signs. Time prevents me from here detailing any of my observations or experiments

with regard to the emotional life of animals, so I will pass on at once to the faculty of Conscience. Of course, the moral sense, as it occurs in ourselves, involves ideas of high abstraction, so that in animals we can only expect to meet with a moral sense in a very rudimentary form; and, therefore, even if it is true that no indications of such a sense are to be met with in animals, the fact would not establish any difference in kind between animal intelligence and human. But I am inclined to believe that in highly-intelligent, highly-sympathetic, and tolerably well-treated animals, the germs of a moral sense become apparent. To give two instances: I once shut up a Skye terrier in a room by himself while I went to a friend's house. The dog must have been thrown into a violent passion at being left behind, for when I returned I found that he had torn the window-curtains to shreds. He was in great joy at seeing me; but as soon as I picked up one of the torn shreds of the curtains the animal gave a howl and ran screaming up the staircase. Now, this dog was never chastised in his life, so that I can only explain his conduct as an expression of the remorse which he suffered at having done in a passion what he knew would cause me annoyance. So far as I can interpret the facts, his sympathetic affection for me, coupled with the memory of his misdeeds, created in his mind a genuine feeling of *repentance*.

The other instance I have to narrate occurred with the same terrier. Only once in his life was he ever known to steal; and on this occasion, when very hungry, he took a cutlet from a table and carried it under a sofa. I saw him perform this act of larceny, but pretended not to have done so, and for a number of minutes he remained under the sofa with his feelings of hunger struggling against his feelings of duty. At last the latter triumphed; for he brought the stolen cutlet and laid it at my feet. Immediately after doing so he again ran under the sofa, and from this retreat no coaxing could draw him. Moreover, when I patted his head he turned away his face in a ludicrously conscience-stricken manner. Now, I regard this instance as particularly valuable, from the fact that the terrier in question had never been beaten, and hence that it cannot have been fear of bodily pain which prompted these actions. On the whole, therefore, I can only suppose that we have in these actions evidence of as high a development of the ethical faculty as is attainable by the logic of feelings when unassisted by the logic of signs—that is to say, a grade very nearly, if not quite, as high as that with which we meet in low savages, young children, many idiots, and uneducated deaf-mutes.

This allusion to savages, children, idiots, and deaf-mutes, leads me to the next division of my subject.

Prof. St. George Mivart has said that an interesting book might be written on the stupidity of animals. I am inclined to think that a still more interesting book might be written on the stupidity of savages. For it is a matter of not the least interest how much stupidity any

number of animals may present, so long as some animals present sufficient sagacity to supply data for the general theory of evolution; while, on the other hand, it is of the utmost importance for the science of this century to ascertain the lowest depths in which the mind of man is known to exist as human. Now, there is no doubt that the interval which separates the most degraded savage from the most intelligent animal is, psychologically considered, enormous; but, enormous as it is, I cannot see any evidence to show that the gulf may not have been bridged over during the countless ages of the past. Abstract ideas among savages are mostly confined to such as may be formed by the logic of the feelings; so that, for instance, according to the observations and the judgment of Mr. Francis Galton, the ideas of number which are presented by the lowest savages are certainly in no degree superior to those which are presented by the higher animals. Such ideas as savages possess seem to be mainly those which, as in animals, are due to special associations. On this account there is in them, as in animals, a remarkable tendency to act in accordance with preformed habits, rather than to strike out improved modes of action. On this account, also, there is, as in animals, a strong tendency to imitation as distinguished from origination. Again, as in animals, so in savages, the reflective power is of an extremely undeveloped character, and quite incapable of sustained application. And, lastly, the emotions of savages, as of animals, are vivid, although, as contrasted with the emotions of civilized man, they are in a marked degree more fitful, impetuous, shallow, and transitory. So that, altogether, I think the lowest savages supply us with a most valuable transition-stage between mind as we know it in ourselves, and mind as we see it manifested by the higher animals.

With regard to children it is to be expected, on the general theory of evolution by inheritance, that if we were attentively to study the order in which their mental faculties develop, we should find that the historical sequence is, as it were, a condensed epitome of the order in which these faculties were developed during the evolution of the human species. And this expectation is fairly well realized. Very young children present only those lower faculties of mind which in animals we call instincts. With advancing age, the first indication of true intelligence seems to consist in the power of forming special associations. Memory thus appears early in life; and, long before a child is able to speak, it links together in thought ideas of objects which it finds to be associated in fact. Again, the emotions begin to assert their presence at a very early period, and attain a high degree of development before any of the characteristically human faculties can be said to have appeared. Moreover, in young children we meet with nearly all the emotions which I have named as occurring in animals, and their general character is much of the same kind. In more advanced childhood the emotional life of children more resembles that of savages. With regard

to the more purely intellectual faculties, language is largely intelligible to a child long before it is itself able to articulate; but, soon after it is able to articulate, the faculty of abstracting qualities and classifying objects by the aid of signs begins its course of development. Thus, for instance, I have lately seen a child who belongs to one of the best of living observers, and who is just beginning to speak. This child called a duck "quack," and by special association it also called water "quack." By an appreciation of the resemblance of qualities, it next extended the term "quack" to denote all birds and insects on the one hand, and all fluid substances on the other. Lastly, by a still more delicate appreciation of resemblance, the child eventually called all coins "quack," because on the back of a French sou it had once seen the representation of an eagle. Hence to this child the sign "quack," from having originally had a very specialized meaning, became more and more extended in its signification, until it now serves to designate such apparently different objects as "fly," "wine," and "shilling." And as in this process we have the initiation of the logic of signs, so we have in it the potentiality of the most abstract thought. Accordingly, soon after a child begins to speak, we find that reason of a properly human kind begins to be developed.

Upon the whole, then, the study of infant psychology yields just the kind of results which the general theory of evolution would lead us to expect. But in comparing the intelligence of a young child with that of an adult animal we are met with this difficulty—that as the bodily powers of children at so immature an age are so insufficiently developed, the mind is not able, as in the case of animals, to accumulate experiences of life. In order, therefore, to obtain a fair parallel, we should require a human being whose mental powers have become arrested in their development at an early age, while the bodily powers have continued to develop to mature age, so serving to supply the aborted human intelligence with full experiences of life. Now, the nearest approach that we have to these conditions is to be found in the case of idiots. Accordingly, in anticipation of this lecture, I have sent a table of questions to all the leading authorities on idiocy, and the answers which I have obtained display a very substantial agreement. Through the kindness of these gentlemen I have also been enabled to examine personally a number of the patients who are under their charge. In particular I have to express my obligations to Drs. Beech, Crichton Browne, Langdon Down, Ireland, Maudsley, Savage, and Shuttleworth. On the present occasion I can only pause to state the leading facts which have been elicited by this inquiry.

As there are all degrees of idiocy, the object of my inquiry was to determine the order in which the various mental faculties become enfeebled and disappear as we descend from the higher to the lower grades of imbecility. On the general theory of evolution we should expect that in such a descending scale the characteristically human, or

the more recently developed, faculties should be the first to disappear, while those faculties which man shares with the lower animals should be the most persistent. And this expectation I have found to be fairly well realized. Beginning from below, the first dawn of intelligence in the ascending scale of idiots, as in the ascending scale of animals, is invariably to be found in the power of associating simple concrete ideas. Thus, there are very few idiots so destitute of intelligence that the appearance of food does not arouse in their minds the idea of eating; and, as we ascend in the scale idiotic, we find the principle of association progressively extending its influence, so that the mind is able, not only to establish a greater and greater number of special associations, but also to retain these associations with an ever-increasing power of memory. In the case of the higher idiots, as in the case of the higher animals, it is surprising in how considerable a degree the faculty of special association is developed, notwithstanding the dwarfed condition of all the higher faculties. Thus, for instance, it is not a difficult matter to teach a clever idiot to play dominos, in the same way as a clever dog has been taught to play dominos, viz., by teaching special associations between the optical appearances of the facets which the game requires to be brought together. But the idiot may be quite as unable as the dog to play at any game which involves the understanding of a simple *rationale*, such, for instance, as draughts. And, similarly, many of the higher idiots have been taught to recognize, by special association, the time on a watch; but it is remarkable that the high power of forming special associations which this fact implies occurs in the same minds which are unable to perform so simple a calculation as this: If it is ten minutes to three, how many minutes is it past two? Thus it will be seen that among idiots, as among animals, the faculty of forming special associations between concrete ideas attains a comparatively high degree of development. Let us then next turn to the faculties of abstraction and reason. Prepared as I was to expect these faculties to be the most deficient, I have been greatly surprised at the degree in which they are so. As regards the power of forming abstract ideas which depend on the logic of signs, it is only among the very highest class of idiots that any such power is apparent at all; and even here it is astonishing in how very small a degree this power is exhibited. There seems, for instance, to be an almost total absence of the idea of right and wrong as such; so that the faculty of conscience, properly so called, can rarely be said to be present. Most of the higher idiots, indeed, experience a feeling of remorse on offending the sympathies of those whom they love, just as did my dog on tearing the window-curtains; but I have been able to obtain very little evidence of any true idiot whose action is prompted by any idea of right and wrong in the abstract, or as apart from the idea of approbation and disapprobation of those whose good feeling he values.

Again, the faculty of reason is dwarfed to the utmost—so much so,

that the investigator is most of all astonished at the poverty of rational power which may be displayed by a human mind that in most other respects seems well developed. I can only wait to give you one example, but it may be taken as typical. A boy fourteen years of age, belonging to the highest class of undoubted idiots, could scarcely be called feeble-minded as regarded many of his faculties. Thus, for instance, his powers of memory were above the average, so that he had no difficulty in learning Latin, French, etc. Moreover, he could tell you by mental calculation the product of two numbers into two numbers, such as 35 by 35, or of one number into three numbers, such as number of days in nine years. His powers of mental calculation were therefore quite equal to those of any average boy of his age. Yet he was not able to answer any question that involved the simplest act of reason. Thus, when I asked him how many sixpences there are in a sovereign, he was quite unable to answer. Although he knew that there are two sixpences in a shilling, and twenty shillings in a sovereign, and could have immediately have said that twice twenty are forty, yet he could not perform the simple act of inference which the question involved. Again, I asked him, if he could buy oranges at a farthing each, how many he could he buy for twopence? He thought long and hard, saying, "I know that four farthings make a penny, and the oranges cost a farthing each; then how many could I buy for twopence? Ah! that's the question, and there's just the puzzle." Nor was he able by the utmost effort to solve the puzzle. This boy had a very just appreciation of his own physiological character. Alluding to his power of forming special associations and retaining them in his excellent memory, he observed: "Once put anything into my head and you don't get it out again very easily; but there's no use in asking me to do puzzles."

Lastly, the emotional life of all the higher idiots, as of all the higher animals, is remarkably vivid as compared with their intellectual life. All the emotions are present (except, perhaps, that of the sublime and the religious emotions), and they occur for the most part in the same order as to strength as that which I have already named in the case of animals. But, more than this, just as in animals, children, and savages, so in idiots, the emotions, although vivid and keen, are not profound. A trivial event will make the higher idiots laugh or cry, and it is easy to hurt their feelings with a slight offense; but the death of a dear relative is very soon forgotten, while the stronger passions, such as love, hate, ambition, etc., do not occur with that force and persistency which properly entitle them to be called by these names.

Upon the whole, then, with regard to idiots, it may be said that we have in them a natural experiment wherein the development of a human mind is arrested at some particular stage, while the body is allowed to continue its growth. Therefore, by arranging idiots in a descending

grade, we obtain, as it were, an inclined plane of human intelligence, which indicates the probable order in which the human faculties have appeared during the history of their development; and, on examining this inclined plane of human intelligence, we find that it runs suggestively parallel with the inclined plane of animal intelligence, as we descend from the higher to the lower forms of psychical life.

I have only time to treat of one other branch of my subject. Believing, as I have said, that language, or the logic of signs, plays so essential a part in developing the higher intellectual life of man, it occurred to me that a valuable test of the truth of this view was to be found in the mental condition of uneducated deaf-mutes. It often happens that deaf and dumb children of poor parents are so far neglected that they are never taught finger-language, or any other system of signs, whereby to converse with their fellow-creatures. The consequence, of course, is that these unfortunate children grow up in a state of intellectual isolation, which is almost as complete as that of any of the lower animals. Now, when such a child grows up and falls into the hands of some competent teacher, it may, of course, be educated, and is then in a position to record its experiences when in its state of intellectual isolation. I have, therefore, obtained all the evidence I can as to the mental condition of such persons, and I find that their testimony is perfectly uniform. In the absence of language, the mind is able to think in the logic of feelings, but can never rise to any ideas of higher abstraction than those which the logic of feelings supplies. The uneducated deaf-mutes have the same notions of right and wrong, cause and effect, and so on, as we have already seen that animals and idiots possess. They always think in the most concrete forms, as shown by their telling us when educated that so long as they were uneducated they always thought in pictures. Moreover, that they cannot attain to ideas of even the lowest degree of abstraction, is shown by the fact that in no one instance have I been able to find evidence of a deaf-mute who, prior to education, had evolved for himself any form of supernaturalism. And this, I think, is remarkable, not only because we might fairly suppose that some rude form of fetichism, or ghost-worship, would not be too abstract a system for the unaided mind of a civilized man to elaborate, but also because the mind in this case is not wholly unaided.[1] On the contrary, the friends of the deaf-mute usually do their utmost to communicate to his mind some idea of whatever form of religion they may happen to possess. Yet it is uniformly found that, in the absence of language, no idea of this kind can be communicated.

[1] Were it not for certain criticisms which have appeared on my lecture as originally delivered, I should have thought it unnecessary to point out that an uneducated deaf-mute inherits the cerebral structure of a man. The fact, therefore, of his having human feelings and expressions of face, as well as the capacity for education, is no proof that language is not necessary for the formation of abstract ideas, unless it could be proved that the human brain might have been what it is, even if the human race had never evolved any system of language.

For instance, the Rev. Mr. S. Smith tells me that one of his pupils, previous to education, supposed the Bible to have been printed by a printing-press in the sky, which was worked by printers of enormous strength—this being the only interpretation the deaf-mute could assign to the gestures whereby his parents sought to make him understand that they believed the Bible to contain a revelation from a God of power who lives in heaven. Similarly, Mr. Graham Bell informs me of another, though similar case, in which the deaf-mute supposed the object of going to church to be that of doing obeisance to the clergy.

On the whole, then, from the mental condition of uneducated deaf-mutes we learn the important lesson that, in the absence of language, the mind of a man is almost on a level with the mind of a brute in respect of its power of forming abstract ideas. So that all our lines of evidence converge to one conclusion: the only difference which analysis can show to obtain between the mind of man and the mind of the lower animals consists in this—that the mind of man has been able to develop the germ of rational thought which is undeveloped in the mind of animals, and that the development of this germ has been due to the power of abstraction which is rendered possible by the faculty of speech. I have, therefore, no hesitation in giving it as my opinion that the faculty of speech is alone the ultimate source of that enormous difference which now obtains between the mind of man and the mind of the lower animals. Is this source of difference adequate to distinguish the mind of man from the mind of the lower animals in kind? I leave you all to answer this question for yourselves. I am satisfied with my work if I have made it clear to you that the question, whether human intelligence differs from animal intelligence in kind or in degree, hinges entirely on the question whether the faculty of speech has been of an origin natural or supernatural. Still, to be candid, when the questions occur to me—Seeing that language is of such prodigious importance as a psychological instrument, does not the presence of language serve to distinguish us in kind from all other forms of life? How is it that no mere brute has ever learned to communicate with its fellows by words? Why has man alone of animals been gifted with the Logos?—I say, when these questions occur to me, I feel that, although from the absence of prehistorical knowledge I am not able to answer them, still, when I reflect on the delicacy of the conditions which, on the naturalistic hypotheses, must first have led to the beginning of articulate language—conditions not only anatomical and physiological, but also psychological and sociological—when I thus reflect, I cease to wonder that the complicated faculty of speech should only have become developed in *Homo sapiens*.

Ladies and gentlemen, I have now given you an organized epitome of the leading results which have been obtained by a study of the facts and the principles of comparative psychology; and, as in doing so I have chiefly sought to address those among you who are interested in

science, I fear that to some of you I must in many places have been very hard to follow. But as a general outcome of the whole lecture—as the great and vivifying principle by which all the facts are more or less connected, and made to spring into a living body of philosophic truth—I will ask you to retain in your memories one cardinal conclusion. We are living in a generation which has witnessed a revolution of thought unparalleled in the history of our race. I do not merely allude to the fact that this is a generation in which all the sciences, without exception, have made a leap of progress such as widely to surpass all previous eras of intellectual activity; but I allude to the fact that in the special science of biology it has been reserved for us to see the first rational enunciation, the first practical demonstration, and the first general acceptance, of the doctrine of evolution. And I allude to this fact as to a fact of unparalleled importance in the history of thought, not only because I know how completely it has transformed the study of life from a mere grouping of disconnected observations to a rational tracing of fundamental principles, but also because it is now plainly to be foreseen that what the philosophy of evolution has already accomplished is but an earnest of what it is destined to achieve. We know the results which have followed in the science of astronomy by the mathematical proof of the law of gravitation; and can we doubt that even more important results will follow in the much more complex science of biology from the practical proof of the law of evolution? I at least can entertain no doubt on this head; and, forasmuch as this enormous change in our means of knowledge and our modes of thought has been so largely due to the almost unaided labors of a single man, I do not hesitate to say, even before so critical an audience as this, that in all the history of science there is no single name worthy of a veneration more profound than the now immortal name of Charles Darwin.

Do you ask me why I close this lecture with such a panegyric on the philosophy of evolution? My answer is: If we have found that in the study of life the theory of descent is the key-note by which all the facts of our science are brought into harmonious relation, we cannot doubt that in our study of mind the theory of descent must be of an importance no less fundamental. And, indeed, even in this our time, which is marked by the first opening dawn of the science of psychology, we have but to look with eyes unprejudiced to see that the philosophy of evolution is here like a rising sun of truth, eclipsing all the lesser lights of previous philosophies, dispelling superstitions like vapors born of darkness, and revealing to our gladdened gaze the wonders of a world till now unseen. So that the cardinal conclusion which I desire you to take away, and to retain in your memories long after all the lesser features of this discourse shall have faded from your thoughts, is the conclusion that mind is everywhere one; and that the study of comparative psychology, no less than the study of comparative anatomy, has hitherto yielded results in full agreement with that great transfor-

mation in our view of things, which, as I have said, is without a parallel in the history of thought, and which it has been the great, the individual glory of this age and nation to achieve.—*Nineteenth Century.*

SKETCH OF DR. PETERMANN.

AUGUST HEINRICH PETERMANN, the world-renowned geographer, whose death under peculiarly painful circumstances was announced a few weeks ago, was born April 18, 1822, at Bleicherode, a small town in the Prussian province of Saxony. His parents destined him for the ministry of the church, and to this end sent him at an early age to the gymnasium or college of Nordhausen, one of the principal towns of his native province. Here he pursued the usual course of study in preparation for the university; but having in the mean time evinced a special liking and aptitude for geographical research, and especially for cartography, he abandoned the idea of entering the ministry, and gained admission to the Royal School of Geographical Art, founded three years previously at Potsdam by the well-known geographer Heinrich Berghaus, who was himself principal of the institution. Here Petermann remained for six years, first as a student, later as Berghaus's secretary and librarian, assisting him also in constructing and designing his great "Physical Atlas." Through this association with Berghaus, Petermann was brought into relations of friendship and intimacy with many of the great travelers and *savants* of the time in Germany, and in particular was so fortunate as to attract the favorable notice of Alexander von Humboldt, who in 1841 employed him to draw a map illustrating his great work, "Asie Centrale."

In 1845, on the completion of Berghaus's "Physical Atlas," Petermann went to Edinburgh, where for two years he assisted the late Alexander Keith Johnston in adapting that work for the use of English readers. From Edinburgh he went to London, whither the fame of his meritorious services to the science of geography had preceded him. He was elected to the Royal Geographical Society, and became one of its most active members. During the seven years which he passed in the British metropolis he weekly contributed to the *Athenæum* notices of geographical progress, reviews of books, and the like. He also wrote geographical articles for the "Encyclopædia Britannica" and for the "English Cyclopædia." In association with the Rev. Thomas Milner he prepared a popular "Atlas of Physical Geography;" he also published many separate maps. He was in no mean degree instrumental in promoting the Richardson-Barth-Overweg expedition sent out in 1849 by the British Government to explore Central Africa. Richardson having died at Unguratua in the spring of 1851, Barth succeeded to the leadership, and on his return to England published in three vol-

umes an account of his travels. The maps illustrating this work were, as the author writes in his preface, "executed with artistic skill and scientific precision by Dr. Petermann." Henceforward the exploration of the "dark continent" was one of the two dominant thoughts of Petermann's mind, the other being north-polar exploration. He has awakened throughout Europe a lively interest in both of these departments of research, and there is no doubt that to him is due much of the advancement made in geographical knowledge during the last thirty years; and recent German explorers of Africa, as Heuglin, Munzinger, Rohlfs, Mauch, Schweinfurth, and Nachtigal, found in Petermann a powerful advocate to enlist popular sympathy for their labors. In high northern exploration he was a believer in an open Polar Sea, therein agreeing with our own great navigators, Kane and Hall, but his favorite route to the pole was along the east coast of Greenland, while our countrymen prefer the route through Davis Strait, along the west coast.

In 1854 he took up his residence at Gotha, having been appointed Director of Justus Perthes's Geographical Institute, the most extensive establishment in the world for the production of maps and charts; this position he held down to his death. That now well-known monthly journal of geography, *Mittheilungen aus Justus Perthes' Geographischer Anstalt*, was founded in 1855, succeeding Berghaus's geographical annual, the "Geographisches Jahrbuch." Petermann assumed the editorship of the new magazine, which quickly reached an eminence unattained by any other periodical of its class. The editor impressed his personality on every page of his magazine, and it is commonly known as *Petermann's Mittheilungen*. It was in the same year, 1855, that he received from the University of Göttingen the degree of Ph. D. Geographical societies throughout the world have enrolled his name in the lists of their honorary membership, and in 1869 the Emperor of Austria conferred on him the order of the Iron Crown, in recognition of his services to arctic exploration. Some years ago he was appointed Professor of Geography in the Polytechnic School at Gotha (*not* in the University of Gotha, as some of the newspapers have it, and that for the sufficient reason that Gotha has no university). He visited the United States in 1876, and was received with fitting honors by the American Geographical Society of New York.

For a few days before his death Petermann suffered from a painful attack of bronchitis, coughing almost continually. At the same time he complained of a headache so intense that the slightest touch of a finger on the forehead caused him an agony of pain. To these physical ills were added domestic troubles of an extremely aggravating kind, and the result was a pitiable state of nervous excitement, amounting almost to frenzy. Life seemed unendurable, and, to terminate his sufferings, the great geographer died by his own hand on September 25th. His father and brother had died in the same manner.

CORRESPONDENCE.

CURIOUS MOUNDS IN CALIFORNIA.

To the Editor of the Popular Science Monthly.

ON the stage-road from Mariposa to Merced—a portion of the Yosemite Valley route—for a distance of twenty miles, the surface of the ground, as far as the eye can see, is singularly characterized.

Circular elevations, like mammæ, about two feet high and twenty feet in diameter, are divided by shallow ditches, or swales, about ten feet wide. These mounds are surprisingly symmetrical, and occupy the whole surface. Where the rising ground meets the sky, the outline is regularly scalloped. The freshets have in some places cut through to the depth of three feet, leaving the vertical section exposed to view.

All the stones contained in the mounds are rounded, and in size are from half an inch to four inches in diameter. None larger were seen. The bottoms of the dry water-courses are paved with these round stones to a considerable depth, the largest on top. For six inches in depth of the surface of the mounds the soil is free of stones; below that, the stones are distributed without much regard to size, the spectator being impressed with the apparent fact that the larger ones are nearer the surface.

Rising ground equally with level surface is covered by these mammæ. In rare cases are two mounds thrown together, so as to interfere with the generally symmetrical arrangement. A plausible explanation of the cause of this phenomenon occurred to me: After the surface had been smoothed, and the large elevations rounded, by the moving glacier, the ice-mass became stationary from diminished thickness. The larger stones on the surface would melt through, forming funnel-shaped cavities, into which the water on the surface of the glacier would pour and run out at the bottom, leaving the accompanying dirt and gravel in a heap. But this theory requires that the stones causing the funnel-shaped cavities should be distributed on the surface of the glacier at uniform distances of twenty-five feet from each other, which supposition is inadmissible.

I am constrained to ask for a proper interpretation of the origin of this notable arrangement. S. H. MEAD.

DAVENPORT, IOWA, *July* 11, 1878.

MUTILATIONS AND HEREDITY.

To the Editor of the Popular Science Monthly.

IN January, 1875, I had a tortoise-shell cat that lost her left fore-paw, as I suppose, in a steel trap. About ten weeks after this accident she had a litter of kittens, and, one being a tortoise-shell, it was saved. The first cat lived about a year. In addition to her limping around on three feet, she had a peculiar habit of holding up the lame foot against her breast, as though she was nursing it, and would frequently come and touch me with it, looking up at me with a pitiful expression on her face. Last spring I obtained a tortoise-shell kitten, a granddaughter of the lame one and a daughter of the cat that was born after the foot was hurt. Now, this kitten has the habit of standing almost constantly on three feet, holding the left one from the ground (sometimes, but not often, she holds up the right one), and she frequently holds it to her breast, as though she were nursing it, in exact imitation of her grandmother, the lame one. She also has the habit of coming up and touching me with her paw, putting on the pitiful expression of countenance that was observed on the face of her ancestor. J. D. A.

CROMWELL, CONNECTICUT, *October* 21, 1878.

DOES THE MICROPHONE MAGNIFY SOUND?

To the Editor of the Popular Science Monthly.

SIR: The account of the actual accomplishments of the microphone, in the way of magnifying faint sounds, as communicated to the Royal Society in May last, was so astonishing that every one was led to believe a scientific discovery of immense value had been given to the world, containing *in embryo* practical applications of unbounded extent.

Not the least remarkable feature of this discovery was the extreme simplicity of the apparatus, thereby enabling the merest *dilettante* to repeat the experiments detailed in Prof. Hughes's paper; and I doubt not that a number of experimenters have expended a good deal of time and patience in endeavoring to develop these embryonic possibilities.

It is for the purpose of eliciting the candid opinion of such workers, who may have been more successful than I, that I am induced, through the medium of your valuable journal (while avoiding theoretical considerations which have been exhaustively discussed), to state very briefly the conclusions that I have arrived at after a careful investigation with microphones of varied form:

1. *The microphone does not magnify*

sound, and we cannot expect it, "when further developed by study, to do for us, with regard to faint sounds, what the microscope does with matter too small for human vision."

We cannot correctly regard the sound heard in the telephone receiver as "a magnified image" of the original vibrations; for, while the fundamental tone is reproduced with considerable accuracy, the harmonics or overtones, giving the *timbre*, or individuality to the sound, are in most cases very imperfectly rendered.

2. If the ear is placed in as favorable a position to hear the original faint vibrations (which jar the delicately-poised piece of carbon) as it is when listening to the telephone, it will be found that the increased volume of sound issuing from the diaphragm of the receiver is more imaginary than real.

For these, and other reasons, the writer is of the opinion that the probable future value of this discovery has been greatly exaggerated, and that it is likely to prove an addition to the rather plentiful crop of scientific green fruit which fails to ripen into the full perfection so enthusiastically predicted by the luxuriance of the blossoms.

Respectfully yours,

A. E. OUTERBRIDGE, JR.,
Assay Laboratory U. S. Mint, Philadelphia.

EDITOR'S TABLE.

ELECTRIC ILLUMINATION.

NOTHING is more natural than that there should be great expectations in the non-scientific mind in regard to what electricity is destined to do for the world in future—expectations which, on the one hand, are grounded in reason, and, on the other, are liable to the most extravagant exaggeration. The marvelous things already accomplished by means of this mysterious agent, as made familiar in the electro-chemical industries, the telegraph, telephone, and electrical illumination, have a tendency, of course, to prepare the mind to look for further unusual and astonishing results. Just now a revolution in illumination is widely anticipated, by which the common illuminants will be superseded in the daily life of the people, through improvements in the electrical light. The probability of this important result is greatly increased, and is, indeed, supposed to have become a certainty, because electrical illumination is already an established fact on a large scale, it having been used in light-houses for years, and successfully introduced into factories, depots, theatres, and other places where large spaces are to be illuminated. So much—the main thing, and apparently everything—being actually gained as a fact of experience, the carrying out of the invention into minor details is taken as a foregone conclusion. In this state of the public mind the announcement of Mr. Edison—the foremost inventive genius of the age—that he had actually solved the problem which would make electric illumination available for common household uses, was generally accepted as a matter of course, and sent a tremor through the gas-stocks of the world. Nevertheless, the desideratum has not yet been reached, and, for aught that actually appears, we are no nearer this important consummation than we were twenty years ago.

It may be well to remind the sanguine believers in this unquestionably most desirable improvement, of the analogous excitement there was, some thirty or forty years ago, in regard to electricity as a motive power. A new source of mechanical energy had been discovered in electro-magnetism, which was developed by appropriate machinery, so as to be capable of doing all kinds of work. There was the accomplished fact, and buzz-saws were driven through two-inch planks, before astonished audiences, merely by batteries in the cellar, connected with the working-machine by conducting wires. The steam-engine was threatened, and we seemed to be on the eve of a new epoch in the use of motive powers.

When scientific men shook their heads and said it would not do—that there were limits in the case which forbade the expected progress, and that zinc burned in batteries could not compete with coal burned under the boiler—the replies were ready. First, did not Dr. Lardner say that steam-navigation across the Atlantic was impracticable? Second, was there any limit to that power of which the lightning-flash was an example? Third, if the electro-magnetic engine was weak, was it not also new, and who would presume to put restrictions upon man's inventive genius, especially when the main thing was already achieved, and nothing remained but to work out the minor improvements? The new motor, however, could not be made to work, and so hopes were crushed, investments lost, and the excitement died away.

The difficulty with the electric light, which has hitherto defied resolution, notwithstanding the efforts of experimenters for a generation, is that it can only be realized under an intensity of action that becomes far too expensive for common use, where only a small amount of illumination is required. A brilliant light can be got from the electric current by the incandescence of carbon or metallic particles, which will flood great spaces with a vivid illumination much cheaper than can be done in any other way, but nobody has yet been able to divide and distribute this intense light so as to utilize it in small amounts, wherever wanted, at a cost that can compete with the ordinary sources of illumination. A well-informed writer in a late issue of the New York *Sun* gives the following instructive presentation of the present aspect of the subject:

"I judge that the panic in gas-stocks, which has been produced in great part by the broad claims of Mr. Edison to the discovery of a practicable method of subdividing the electric light, is, to say the least, premature. Mr. Edison is now experimenting with his light, and at latest accounts had not solved all the problems involved. The field in which he is laboring is an entirely new one to him, as the science of magneto- or dynamo-electricity is far different from that of telegraphy or electro-magnetism. There are problems involved, especially in the subdivision of the light, which are far greater than any embodied in any previous invention or improvement of Mr. Edison. The scientific world has been laboring at it almost constantly since King's invention in 1848. In 1858 M. Jobart, of Paris, made some very startling claims, which were almost exactly the same as those made by Edison, but continued experiment exposed their fallacy.

"The principal difficulty to be overcome is the lack of economy in any method of producing light by electricity, except by the voltaic arc between carbon-points, and as Mr. Edison disclaims this method, and limits himself to the plan of incandescence, he will find his path beset with difficulties in this direction. This is shown by the well-known fact that an electrical current of a given strength will yield about ten times as much light when used to produce the voltaic arc between carbon-points as it could by being passed through a piece of platinum, so as to raise it to a white heat and give the light. In some experiments recently made in Paris by M. Fontaine, it was found that a powerful battery of forty-eight elements would produce in one lamp a light by incandescence equal to forty burners; but that, when the same current was used in two lamps, the light in each was only three to five burners, and, when divided between three lamps, only one-quarter burner in each. Further subdivision resulted in a total extinction of the light. A similar result was reached whether the lamps were placed in series in the same circuit or in derived circuits. In using a dynamo-electric machine in place of a battery as the source of the electricity, the same difficulty would present itself, with this additional one, that whereas the electro-motive force of a battery remains constant under all changes of resistance, that of a machine does not, but decreases as the resistance increases.

"The writer has thoroughly investigated the subject of electric light as an economical subtitute for gas, and is entirely familiar with all that has been accomplished here or abroad in this direction. Abroad, by means of the Gramme machine and the Jablochkoff candle, sixteen lights of 700-candle power each are produced from one machine, ab-

sorbing sixteen-horse power. The candles cost sixteen cents each, and burn an hour and a half. Estimates of its cost vary from one-half to three times the cost of gas. In this country the field is occupied by several kinds of apparatus. At the American Institute Fair are a number of Wallace machines, furnishing in all nineteen lights, scattered through the main building. Inquiry from the engineer who cares for the engine driving these machines develops the fact that not less than sixty-horse power is consumed for these nineteen lights. In the machinery halls four lights are used, furnished by a Brush machine absorbing seven-horse power. These are much steadier and pleasanter to the eye than those in the main building. The makers of the Brush machine claim that, with a larger machine, absorbing twelve-horse power, they can produce fifteen to twenty lights of 2,000-candle power each, thus considerably improving upon the French system.

"Unless Mr. Edison can substantiate his claims, and produce better results than are given above—and there is not the slightest evidence that he has actually done even as much—the conclusion clearly reached is this: that, for the lighting of dwellings and all places where twenty or thirty or perhaps forty gas-burners suffice, gas will hold its own and still be the most economical light."

Upon the reception of the news in England of what Mr. Edison had done and proposed to do, there was perturbation in gas-stocks, and the editor of *Nature* writes as follows about it:

"Although a student of science will have little difficulty in associating the results promised with the discovery of perpetual motion, it is quite probable that Mr. Edison has actually succeeded in doing what he states he has done in his telegram: 'I have just solved the problem of the subdivision of the electric light indefinitely.' What we wish to point out is, that it is one thing to do this and another thing to produce an electric light for ordinary house and street use. Once put the molecules of solid carbon in motion, and, just because a solid is in question, the light must be excessive and the expenditure of energy must be considerable.

"While it is easy to believe that the future may produce a means of illumination midway between the electric light and gas, it is equally easy to see that the thing is impossible without great waste, and therefore cost, with dynamo-electric machines and carbon-poles. So long as carbon is employed we shall have much light which, perhaps, can be increased and steadied if various gases and pressures are tried. But streets and rooms full of such suns as these would be unbearable unless we sacrifice much of the light after we have got it. Split up the current in the manner so cheerfully described by the New York paper, and the carbon will refuse to flow altogether, if an engine of 5,000,000 horse-power be employed instead of the modest one of 500 which is to light the south part of the island. If Mr. Edison has succeeded in replacing carbon he may have turned the flank of the difficulty to a certain extent.

"Gas companies may well begin to feel uneasy at the general attention which is being drawn to the electric light as a substitute for gas *if they are prepared to let things alone*. That in one form or another it is likely to be partially adopted in all large cities and at extensive public works seems most likely. It will be one of the lights of the future, but not to the excluding or superseding of gaslight.

"Our own columns have repeatedly borne testimony to the success which has attended its introduction into Paris, where it is to be met with at almost every corner, and at one or more of the railway-stations. The general testimony of those who are unprejudiced is, that at least for wide streets, squares, and open places, its lighting effect is all that could be desired. Every Londoner is familiar with the effect of the display which the enterprising Mr. Hollingshead has placed in front of the Gaiety Theatre, and the glowing contrast presented to the miserable yellow flames of the neighboring street-lamps; but this contrast exists because the gas is bad and dear. Mr. Hollingshead, in a letter to the *Daily News*, corrects the view of the gas companies, that the electric light must necessarily cost more to produce than gas. His own display, necessarily wasteful, costs four-fifths what gas would, and he is probably correct in saying that with proper management it need not cost more than one-half. Moreover, in yesterday's *Times*, Mr. E. J. Reed refers to the case of M. E. Manchon, a large manufacturer at Rouen, who had gone to considerable expense to alter his premises to suit the electric light, and who, even with hired engine-power, finds that there is an annual saving of 22.6 per cent. over gas, with infinitely better light and a wholesome atmosphere. Mr. Reed is of opinion that, even if the electric light cost more than gas, its advantages

are so great that, for the lighting of public places, museums, art-galleries, manufactories, etc., he would advocate its general introduction. Even Madrid, one of the most backward cities in Europe, has introduced the light, one great benefit of which, especially in theatres and other much-frequented places, is that the heat generated and the contamination of the air are greatly less than in the case of gas.

"Let the directors of gas companies do all they can to improve their gas. They may be certain that it will never cease to be required; a considerable splitting up of the electric current is impossible, while the brilliant light that we shall always get when electricity is employed will gradually so raise the *pitch* of illumination that more gas than ever will be used."

VANDERBILT UNIVERSITY AGAIN.

COMMODORE VANDERBILT built wiser than he knew in rearing a university at Nashville for the benefit of the Tennessee Methodists, as it is obvious they stand in sore need of education. The Tennessee Conference, meeting in Clarksville in the middle of October, went into the question of education through the report of a special committee, which may thus fairly be taken as indicating the high-water mark of the intelligence and liberality reached by that denomination, in that State, upon that subject. The result shows that the region is excellent missionary-ground for the schoolmaster. It is hardly to be supposed that the inferior schools will be in advance of the higher institutions; and this interests us in what they have to say regarding the character of their new university. The conference applauds it in unmeasured terms, and calls especial attention to the remarkable intellectual influence exerted upon the nascent Tennessee mind by Commodore Vanderbilt's building. They say, "There is an immense educating power in the surpassing beauty of the grounds, the finished elegance of the building, and all that pertains to it." Of this we do not complain. It is indeed ascribing more educational potency to stocks and stones than has been our wont, and leaves Buckle with his "Aspects of Nature," and Spencer with his "environments," far behind; but the conference might well indulge in a little exaggeration out of compliment to the sagacity of the learned and pious founder of the establishment, which could exert this "immense educating power" even before its doors were opened. And it becomes a serious question whether the authorities of the institution might not better have trusted entirely to this silent tuition of structure and surroundings, and not have undertaken to superadd any influences from within. The educational work of Commodore Vanderbilt's architects and landscape-gardeners, whether slight or "immense," is at all events real, honest, and unperverted, which is a good deal more than can be said of the backward and benighted inculcations that are dispensed by the living vocal teachers. We gave an illustration not long ago of the bigotry and intolerance exhibited by the authorities of Vanderbilt University in abruptly dismissing from his position an able professor of science because he taught the present state of knowledge upon the subject confided to his charge. He reported what Science has to say at the present time concerning the antiquity and history of the ancient races of men, and, as this was supposed to conflict with certain old theological dogmas held dear by the Tennessee Methodists, he was summarily ejected from his professorial chair. The proceeding was evidently in imitation of very obsolete precedents, but it proved highly gratifying to the Tennessee Conference. They say:

"The university has afforded us intense gratification by its recent action. This is the age in which scientific atheism, having divested itself of the habiliments that most adorn and dignify humanity, walks abroad in shameless denudation. The arrogant and impertinent claims of this science, falsely so called, have been so boisterous and per-

sistent that the unthinking masses have been sadly deluded. But our university alone has had the courage to lay its young but vigorous hand upon the mane of untamed speculation and say: 'We will have no more of this. Science we want, no crude, undigested theories for the sons of our patrons. Science we must have, science we intend to have, but we want only science clearly demonstrated, and we have great cause to rejoice in this step, for it deals a blow the force of which scientific atheism will find it exceedingly difficult to break.'"

If any one doubts that there is a crying need of the elementary schoolmaster in Tennessee, the literary quality of this official utterance in behalf of a great university will probably be sufficient to settle the matter. But the passage has a more serious aspect. In the announcement for 1878–'79, the first purpose of Vanderbilt University is stated to be the "protection of the morals" of youth during the period of their pupilage. We respectfully suggest that this protection is equally needed for the clergymen of the Tennessee Conference, who seem to have not even a rudimentary conception of the immorality of falsehood and slander. Dr. Winchell, an eminent geologist and scientific scholar, and also a man of known religious character, who had freely published his views and had been but recently chosen as a member of the faculty of the institution, was displaced from his position because the authorities did not agree with all his views; and the Methodist Conference of the State "rejoices" and expresses its "intense gratification" at this blow dealt at "scientific atheism." Dr. Winchell is thus branded with a false and libelous charge by a body of religious teachers which pretends to commend the university as a protector of morals! It is bad enough for the institution to have to stand the consequences of its bigotry and intolerance in this age of growing liberalization, but it might well have been spared this official defense of the denomination to which it belongs.

HUXLEY ON THE RIGHTS OF AUTHORS.

THE unsettled state of copyright legislation and the progress of communistic ideas in relation to literary property give interest to all intelligent discussion of the nature and extent of literary rights. We last month gave the evidence of Prof. Tyndall before the English copyright commission on this subject, and we now follow it by that of Prof. Huxley to the same purpose. The commission had various practical things before it, but it gave thorough attention to the fundamental question of the basis of property in published works, and in this Americans are quite as much interested as the English.

The testimony furnished to our readers was elicited by a systematic attempt so to undermine the rights of authors to their books as substantially to break them down. Several able men connected with the copyright commission, either as members of it or as witnesses before it, took the ground that literary property is not like other property, and differs from it in such a manner that Government may interfere to regulate it in a way that amounts to the subversion of it. They say that, as long as an author keeps his book to himself, he owns it; but when he publishes it he parts with it, he surrenders it, and the public then become its owner, and Government may properly appoint an agent to take charge of it and do with it as the authorities please. Unwilling to push the doctrine to the logical extreme of barefaced, downright communism, by stripping the author clean of his property, these parties maintained that government should merely enter into its possession and manage it for him, allowing him such fraction of the profits as it pleased. In lieu of the existing copyright, by which an author makes such a bargain with the publisher as suits both parties, they proposed what is called a "royalty" system, by which anybody who pleases

may print an author's work, by paying him a small percentage, to be determined by the politicians. That department of Government in England which is specially charged with the administration of copyrights is the Board of Trade, and its secretary, Mr. T. H. Farrer, was a member of the commission, and came forward as the chief champion of the royalty scheme. He took the ground that the existing copyright is a monopoly which it is for the interest of society to destroy, and that the royalty system is called for by the principles of free trade. His main coadjutors in managing the case were Sir Henry Drummond Wolff and Sir Louis Mallet, whose position on the subject of copyright was commented upon in the September MONTHLY. It is a credit to the authorities by whom the commission was constituted, that it was made so broad as to bring out the opponents of copyright in all their strength, and give them every chance to make the best case possible; and that their report embodied sound and conservative recommendations is no doubt largely owing to the ability of such testimony as that herewith published from Prof. Huxley. We shall next month give the interesting evidence of Herbert Spencer before the commission.

LITERARY NOTICES.

ALL AROUND THE HOUSE; OR, HOW TO MAKE HOMES HAPPY. By Mrs. H. W. BEECHER. New York: D. Appleton & Co. Pp. 461. Price, $1.50.

MRS. BEECHER'S new book, as its title happily imports, is devoted to the general interests of the household, and not to any one of its specialties. It is a result of the writer's observation and experience, which have been very considerable, and it may be said to correspond to those important books put forth by physicians of large opportunities under the title of "Practice;" so that, as we have Fergusson's "Practice of Surgery," we may be also said to have Mrs. Beecher's "Domestic Practice." She speaks as a working housekeeper who has had varied trial in the administration of home affairs, and her book is full of useful instruction and wise common-sense, which cannot fail to be valuable to those of her sex who are entering upon the duties and responsibilities of family management, and who have any solicitude about doing their work well. We are glad to see that Mrs. Beecher is thoroughly imbued with the true spirit of her subject. She has an elevated ideal of what a home should be; she understands that it cannot be realized without effort, capacity, and preparation, and keenly realizes how little there is done in any thorough or comprehensive way to qualify woman for intelligent or efficient activity in the domestic sphere.

It is certainly a painful reflection that of all the vocations which human beings pursue, in these times of abounding education, none are entered upon so lightly, so carelessly, and with such an utter absence of all adequate qualification, as that of housekeeping, or, as Mrs. Beecher significantly puts it, of "*home-making*;" while, of all the sources of human misery, there is none that yields a more copious measure of wretchedness than the incapacity of woman to take judicious and intelligent charge of household affairs. Everything else must be prepared for, but "home-making" is thought to need no serious preparation. Yet the interests involved are to the last degree varied, complex, and delicate, requiring knowledge, tact, judgment, patience, in fact the highest accomplishments of character. The interests of the office, the counting-house, the school, are simplicity itself compared with those of the household, where diet, clothing, health, the management of children, the control of servants, the duties of hospitality, and the direction of many stubborn elements, demand intellectual and moral attributes of the highest order on the part of the heads of the house, and in a sphere which mainly belongs to woman. And yet this is the one and almost the only department of our social activity for which no preliminary training is provided in any systematic way. The doctor, the lawyer, the clergyman, the miner, the farmer, and even

the accountant, the dentist, and the farrier, each has his college, but where is the college for the "home-maker?" Its necessity is not even perceived. The women are trying with might and main to get into nearly all the colleges that have grown up as preparations for the business of men, and, when they attempt to make one of their own, they are content to imitate as far as possible those of the opposite sex, and never think of demanding institutions in which they may be educated for that line of activity which the great majority of them are destined to pursue.

Mrs. Beecher sees clearly enough that the modern tendency of feminine culture is not in the direction of home improvement, and that whatever is done in the way of help to this end must come in the shape of such occasional contributions as ladies interested in the subject are prompted to offer. She has a chapter on "Home Colleges," which is an excellent idea, as nothing better is yet to be had, while her volume will serve as an admirable text-book for it. The work is well suited where the class-drill is not very severe, being lively and interesting in its manner, as well as useful and instructive in the information it gives. We have read it through with profit, and cordially recommend it to everybody who lives in a house—especially if it has a plurality of occupants. If the hundred pages of receipts at the close (which are no doubt in themselves excellent) were omitted, the volume would make a first-rate reading-book for girls' schools.

UNITED STATES COMMISSION OF FISH AND FISHERIES. Report for 1875–'76. Washington: Government Printing-Office. Pp. 1079. 1876.

IN the popular mind, the sole aim and object of the United States Commission of Fish and Fisheries is to devise and apply measures for the increase of the fish-supply in our lakes, rivers, and smaller streams; but in fact the commission is also charged with the duty of promoting by its researches the interest of the sea-fisheries, and hence it is that much of the present volume—indeed, by far the greater part of it—is taken up with an historical and statistical account of the American whale-fishery. We are inclined to think that it would be best to restrict the labors of the commission to the one department of propagation of food-fishes. The "History of American Whaling" is no doubt very interesting and valuable, but it has no organic relation to the work of the Fish Commission. The commissioner, Prof. Baird, in the report proper, first briefly rehearses the history of the commission; then details the results of the inquiries that have been made into the decrease of the food-fishes; next he reviews the work that has been done in the propagation of food-fishes; and, finally, gives tables showing the number of fish distributed by the commission since the beginning of its work. Then follows Appendix A (780 pages), on the "American Whale-Fishery." Appendix B, "The Inland Fisheries," comprises reports on "The Fisheries of Chicago and Vicinity," on "The Salmon-Fisheries of the Columbia," and "Notes on some Fishes of the Delaware." There are five papers in Appendix C, treating of the carp, the shad, the Schoodic salmon, salmon-breeding in the McCloud River, and the exportation of fishes and hatching apparatus to various foreign countries.

THE LIFE OF GEORGE COMBE. By CHARLES GIBBON. London: Macmillan & Co. 2 vols. Pp. 739. Price, $8.

IT may be thought that an elaborate two-volume biography, issued twenty years after the death of its subject, whose chief claim to be remembered is the close association of his name with a science which is now generally considered as belonging to the past, must rank as a not very judicious literary venture. No doubt a smaller and more inexpensive work would have had a wider sale, yet it is better that the work should have been done just as it has been done. While merely because he was an eminent phrenologist it would not have been worth while to write Combe's life at all, yet as the author of the "Constitution of Man," and as the representative of a transition period in knowledge and education, and as giving us an account of a very interesting character, the biography deserved to be fully written out. That Combe regarded phrenology as the key to all knowledge, that he devoted himself to it with great assiduity, and applied it everywhere as a sufficient

philosophy of human nature, are by no means the real grounds on which he is entitled to be remembered. Phrenology represented a mere point of view from which humanity was to be studied, and that *point of view* was the true one, and a great advance on all previous systems. Phrenology was the rude means of first bringing mental phenomena into relation with organization, in the popular thought. It was almost inevitable that the first theories of this relation should be deficient and erroneous; but, the attitude taken being correct, valuable results flowed from it. It is on account of his views and reformatory labors regarding education, the treatment of the insane, the true principles of prison discipline, and the emancipation of the masses from social and religious prejudices, that Mr. Combe deserves to be gratefully and honorably remembered, and in this respect his biography is of living and permanent interest.

DETERIORATION AND RACE EDUCATION; WITH PRACTICAL APPLICATIONS TO THE CONDITION OF THE PEOPLE AND INDUSTRY. By SAMUEL ROYCE. Boston: Lee & Shepard. Pp. 585. Price, $2.50.

WE noticed this instructive work upon its first appearance last year, and are glad to see that it has gone to a second edition, as it contains a great deal of information, bearing upon the subject of education, that cannot be found compiled and digested elsewhere. Mr. Royce views the subject in its broadest aspects, laying great stress upon those forces in society which lead to pauperism and physical, mental, and moral degeneracy, and it is as a corrective of these evil tendencies that he chiefly regards the subject of education. The fundamental idea of his work, illustrated and enforced by numerous facts and copious discussion, is that the great deficiency in our system of mental cultivation is the non-recognition of the element of industry. In the new edition of the book he has added nearly one hundred pages, designed to give increasing effect to this aspect of his general argument. In the first place he demands that education shall include learning to work or an actual preparation for industrial occupations. He appreciates and favors the Kindergarten as the first step in this direction, to be followed up by developing schools and technical institutions to teach the practice as well as the elementary principles of various mechanical trades. He gives an interesting account of several industrial schools and manual institutes, chiefly in New England, which have for their object the training of the young in the skillful and intelligent exercise of hand-labor. Mr. Royce points out the vicious and lamentable influence of the existing system of education, in disqualifying the young for entering upon industrial occupations, by presenting false ideas of life through the excessive and one-sided influence of literature and books alone. It is not the worst, he thinks, that working-studies are ignored, but that in our existing schools there arises a prejudice against manual labor, a contempt of it, and an ambition to get a living by head-work in the practice of the professions. Thousands upon thousands who can never enter the professions, and who have not intellectual faculty enough to win success in life by pure intellectual labor, are nevertheless set upon this track, and unfitted for the honest and efficient pursuit of industrial avocations. Want of space prevents our giving several important quotations from this part of Mr. Royce's book, which readers specially interested in the subject will find it useful to procure.

SUPERSTITION IN ALL AGES. By JOHN MESLIER. Translated from the French by Miss Anna Knoop. New York: Liberal Publishing Co., 141 Eighth Street. Pp. 339. Price, $1.50.

THE author of this curious book was born in 1678, in the French village of Mazerny, and died in 1733, at the age of fifty-five. He has, therefore, been dead nearly one hundred and fifty years; and, although his name is not to be found in any of our common cyclopædias, his book, the only one that he ever wrote, is now first translated into English, and is published in the United States.

Meslier was a Roman Catholic priest, and was for thirty years curate of Entrepigny in Champagne. There is a brief sketch of his life by Voltaire prefixed to the volume, from which we gather that he was a quiet, studious man, of a philosophic turn of mind, who at the seminary devoted

himself to the system of Descartes. He is said to have been strictly just and warmly benevolent, attending regularly and faithfully to his clerical duties, and at the end of each year giving what remained of his salary to the poor of his parish.

The following incident is recorded as illustrative of his character: "The lord of his village, M. de Touilly, having ill-treated some peasants, he refused to pray for him in his service. M. de Mailly, Archbishop of Rheims, before whom the case was brought, condemned him. But, the Sunday which followed this decision, the Abbot Meslier stood in his pulpit and complained of the sentence of the cardinal. 'This is,' said he, 'the general fate of the poor country priest; the archbishops, who are great lords, scorn them, and do not listen to them. Therefore, let us pray for the lord of this place. We will pray for Antoine de Touilly, that he may be converted, and granted the grace that he may not wrong the poor and despoil the orphans.' His lordship, who was present at this mortifying supplication, brought more complaints before the same archbishop, who ordered the curate Meslier to come to Douchey, where he ill-treated him with abusive language."

So there was nothing remarkable or unusual about the outward career of this country preacher that was not suitable to be immediately buried in oblivion. But he had been long and quietly at work in a way that was calculated to give interest and notoriety to his name after he had finally left the scene of his labors, where he died in the odor of sanctity. Meslier, it must be said, to the great scandal of his name, did not believe in the theology that he preached. But he lived in times in which men were not very powerfully solicited to express their independent opinions, and, as Meslier said he did not want to be burned alive on account of what he thought, he prudently followed the example of Copernicus and postponed publishing his real views till after he was out of the way. When Meslier was gone, there was found in his house a manuscript volume entitled "Common-Sense," written in his hand, and addressed as "My Testament" to his parishioners. The book was printed, and went through various editions in the eighteenth century, and it is this which is now revised and translated by Miss Knoop. Of its quality the reader can judge from a remark of Voltaire in a letter to D'Alembert, which is as follows: "They have printed in Holland the Testament of Jean Meslier; I trembled with horror in reading it. The testimony of a priest who, in dying, asks God's pardon for having taught Christianity, must be a great weight in the balance of liberals. I will send you a volume of this testament of the anti-Christ, because you desire to refute it."

We have not read this book, and are, therefore, unable to form a critical judgment of it; but Mr. James Parton writes to its translator concerning it as follows: "The work of the honest pastor, Jean Meslier, is the most curious and the most powerful thing of the kind which the last century produced. Thomas Paine's 'Age of Reason' is mere milk-and-water to it, and Voltaire's 'Philosophical Dictionary' is a basket of champagne compared with a cask of fourth-proof brandy. Paine and Voltaire had reserves, but Jean Meslier had none. He keeps nothing back; and yet, after all, the wonder is not that there should have been one priest who left that testimony at his death, but that all priests do not. True, there is a great deal more to be said about religion, which I believe to be an eternal necessity of human nature, but no man has uttered the negative side of the matter with so much candor and completeness as Jean Meslier. You have done a virtuous and humane act in translating his book so well."

THE AMERICAN ANTIQUARIAN: A Quarterly Journal devoted to early American History, Ethnology, and Archæology. Edited by Rev. STEPHEN D. PEET, Unionville, Ohio. Cleveland, Ohio: Published by Brooks, Schinkel & Co. Price, $2 a year, or 50 cents a number.

THE rapid growth of the biological sciences, initiated by the publication of the "Origin of Species" nearly twenty years ago, has brought into especial prominence the great questions of the origin, antiquity, and development of man; and from subjects of theological speculation has transformed them into well-recognized problems of physical science. All the various lines

of biological inquiry converge in this direction; and, as pointed out by Prof. Huxley in his address on "The Progress of Anthropology," published in the October number of this journal, that science has already gained a well-established place, counts among its numerous workers a large number of eminent men, and promises to remain, for many years to come, the chief centre of scientific interest in all countries where science is cultivated.

Up to within a few years most of the work in this department has been done abroad, and the Anthropological Societies of Paris, London, and Berlin, each with its special organ for making known the fruits of research, and with a large and distinguished membership, show the wise provisions that have been made for the prosecution of future investigations.

Although commonly spoken of as the "New World," it is becoming daily more apparent that this continent has had a past that is full of interest for the archæologist and ethnologist, and out of which much is yet to be gathered that will throw light on the interesting problems involved. American investigators are already numerous, and the publication before us meets an important want, in supplying an authoritative medium for the announcement of discoveries, the discussion of new views, and the presentation of the results of American research. The broad ground it is intended to cover is thus stated in the prospectus:

"The Early History, Exploration, Discoveries, and Settlement of the different portions of the Continent.

"The Native Races, their Physical and Mental Traits, Social Organizations and Tribal Distinctions; their Religious Customs, Beliefs, and Traditions, as well as their earlier and later Migrations and changes.

"The Antiquities of America, especially the Prehistoric Relics and Remains, or any evidences as to Ancient Earthworks and Structures, Inscriptions, Hieroglyphics, Signs, and Symbols.

"Prehistoric Man, his Origin, Antiquity, Geological Position, and Physical Structure.

"*The Antiquarian* will also treat of subjects of a more general character, such as The Descent of Man, The Rise of Society, The Origin of Writing, The Growth of Language, The History of Architecture, The Evolution of Ornament, and Ceremonial Observances, Comparative Religions, Serpent-Worship and Religious Symbols, Man and the Mastodon, Man and Animals, Earth and Man, and many other topics which are connected with the Science of Anthropology, especially as they are viewed by the antiquarian.

"Besides these topics especial arrangements have been made by which articles will be contributed upon Archæological Relics, upon Aboriginal Languages and Dialects, and upon the Traditions of this Continent compared with those of other lands.

"The Investigations made by different Historical and Scientific Societies, as well as the Results of all Explorations and Discoveries, will also be reported as far as possible.

"In the editorial management the assistance of several prominent gentlemen has been secured."

The present number contains nine articles, all of them on topics of interest, and several finely illustrated. There is also a valuable editorial department, made up of contributions from several distinguished writers besides the editor-in-chief. The magazine is a credit to American science, and deserves to be well sustained.

THE PARKS AND GARDENS OF PARIS. Considered in Relation to the Wants of other Cities, and of Public and Private Gardens. By W. ROBINSON, F. L. S. Second edition, revised. Illustrated. London: Macmillan & Co. Pp. 548. Price, $7.50.

THE object of this work is to acquaint the reader with those important points of general public gardening, and of fruit and vegetable culture, in which France is in advance of other countries. The author, who has traveled extensively and given prolonged and careful attention to the subjects treated, looks upon English agriculture and rural affairs in general as far before those of France, yet in many important matters he shows that there is much to be learned of the French. The first half of the book is devoted to the parks and gardens in and about Paris, and to the squares, avenues, boulevards, and other improvements, of new Paris. In his criticisms, the aim of the author has been "not only to record and illustrate what is good in them, but also to point out what is harmful." While he finds much to learn and much to admire in their public grounds, yet of the cemeteries he says that "their best aspects are painful to any one who knows what is possible, or what has already been accomplished in the formation of decent burial-grounds near large cities." After a most

revolting account of the mode of burial of the poor in Père-Lachaise, the statement follows that "the Americans are the only people who bury their dead decently and beautifully—that is, so far as the present mode of sepulture will allow them. For beauty, extent, careful planting, picturesque views and keeping, the garden cemeteries formed within the past generation near all the principal American cities are a great advance upon anything of the kind in Europe."

In horticulture the questions discussed are such as the skillful cultivation of hardy fruit-trees, which has made fruit so good and plentiful in France, and has led to its large exportation; the remarkable culture of asparagus, by which it is grown so abundantly that for many weeks in the spring it is an article of popular consumption; Parisian mushroom-culture; lettuce-growing in winter and spring in the suburbs of Paris, by a method so successful that they are able to supply their own market and that of many other cities. When these tender lettuces are eaten in winter, in England, they are supposed to come from some soft southern climate, while in fact they grow in a climate as harsh as that of England. The various processes by which these results are gained are minutely described, and every page of the volume is full of interest and instruction. There are 538 superb illustrations, many of which, in the chapters upon the parks and gardens, are full-page views of scenery and architecture.

TRIBES OF CALIFORNIA. By STEPHEN POWER. Washington: Government Printing-Office. Pp. 635. 1877.

THE aborigines of California differ from the Atlantic tribes in sundry essential particulars, but most of all, perhaps, in their unwarlike temper. They are a humble and lowly race, one of the lowest on earth; yet the story of their lives might convey to more favored races many a lesson of thrift, contentment, and even of manly virtue. The author has lived among these Indians for three years, studying their manners and customs with intelligent sympathy, and his book is full of most curious information concerning their social, political, and religious usages. We must not omit to add that the work evinces in Mr. Power no mean degree of literary skill; hence it is "as interesting as a romance." It is illustrated with a number of excellent plates. There is an appendix on "Linguistics," by Major Powell (of whose "Contributions to North American Ethnology" this work forms Vol. III.), containing comparative vocabularies of the various dialects spoken by the native races of California. The large map which accompanies the volume shows the distribution of the different tribes throughout the State.

AMERICAN COLLEGES: THEIR STUDENTS AND WORK. By CHARLES H. THWING. G. P. Putnam's Sons. Pp. 159. Price, $1.

THIS is a carefully-digested and useful little volume, giving a great deal of information in relation to American collegiate institutions. It treats of "Expenses," "Morals," "Religion," "Societies," "Athletics," "College Journalism," "Fellowships," "Chairs of a College," and "Rank in College as a Test of Distinction."

A DICTIONARY OF MUSIC AND MUSICIANS. Edited by GEORGE GROVE. Part IV. Macmillan & Co. Price, $1.25.

THIS number runs from "Concert-Spirituel" to "Ferrara," and, like the former numbers, is full of musical science, art, erudition, and biography. The work improves with every number.

PUBLICATIONS RECEIVED.

Sanitary Examination of Water, Air, and Food. By Dr. Cornelius B. Fox. Philadelphia: Lindsay & Blakiston. 1878. Pp. 528.

Life in other Worlds. By Dr. Adam Miller. Chicago: Fox, Cole & Co. 1878. Pp. 282. $1.50.

The Old House altered. By George C. Mason. New York: Putnam's Sons. 1878. Pp. 179. $2.50.

The Proportions of the Steam-Engine. By William D. Marks. Philadelphia: J. B. Lippincott & Co. 1879. Pp. 161.

How to parse. By Rev. Edwin A. Abbott. Boston: Roberts Brothers. 1878. Pp. 374. $1.

Introductory Chemical Practice. By G. C. Caldwell and A. A. Breneman. New York: Van Nostrand. 1878. Pp. 170. $1.50.

Zoölogy of the Vertebrate Animals. By Dr. Alexander Macalister. New York: Holt & Co. 1878. Pp. 146. 60 cents.

Outlines of Ontological Science. By H. N. Day. New York: Putnam's Sons. 1878. Pp. 452. $1.75.

The Blessed Bees. By J. Allen. Pp. 169. $1.

Flower Painting. Same publishers. Pp. 46. 50 cents.

A New Exposition of the Leading Facts of Geology. By Gideon Frost. New York. 1869. Pp. 80.

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Artificial Mounds of Northeastern Iowa. By W. J. McGee. From *American Journal of Science.* Pp. 7.

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Recording Articulate Vibrations. By E. W. Blake, Jr. From *American Journal of Science.* Pp. 6.

The Religion of Philosophy. By W. H. Boughton. Pp. 19.

On Repulsion resulting from Radiation. By William Crookes, F. R. S. From "Transactions of the Royal Society." 1878. Pp. 76.

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POPULAR MISCELLANY.

A Hairy Water-Tortoise.—The following interesting bit of natural history is from the pen of Mr. Frank Buckland, in *Land and Water:* "Through the kindness of Mr. White, son of the late lord-mayor, I am enabled to give a representation of a most interesting little creature which he himself brought from China. It is a terrapin, or water-tortoise, which apparently has hairs growing out from its back. When it first arrived it seemed very unwell, and I do not wonder, for the poor little thing had not had anything to eat for some months. Knowing it was very intolerant of cold, I placed it in warm water, and kept it in a warm place, and the little thing shortly, to my delight, began to feed from my hand. It will snap at and devour little bits of meat, fish, shrimps, etc. As the little animal swims, the fibre of the vegetable growth hangs away from him so as to give him the appearance of an animated bunch of weeds. His face is very intelligent.

"Among the collection of Chinese and Japanese bronzes, drawings, pottery, etc., I have observed representations of various monsters, and among them those of tortoises with long tails. It now is certain from this specimen, so kindly given me by Mr. White, that the Chinese really have in their aquaria terrapins covered with this remarkable growth. If the hairy terrapins of the Chinese artists be founded on actual living specimens, may it not be possible that other of these well-known monstrosities—such as dragons—may have their origin from traditions, or may be late survivals of such creatures as the plesiosaurus, etc.? I have read somewhere that the Chinese are the direct descendants of Noah, and that when Shem, Ham, and Japheth, went respectively north, south, and west, Noah himself went east, and founded the great Chinese nation. Certain it is that they have traditions of birds and animals totally unknown to the present inhabitants of the earth. I do not know whether the growth upon this terrapin's back has been produced artificially or naturally. It is simply a water-grass, something like the weedy material growing on decaying wood-work and lock-gates of rivers. It is possible that the ingenious Chinese may have some way of doctoring up the living specimens of terrapins, of which I understand considerable numbers exist in the ditches and marshes of China. These Chinese, as we are all aware, are stated to have the art of making the large fresh-water pearl-bearing mussels secrete pearls, and cover over metal images placed within the shells for that purpose. If they can do this with the pearl shell, I do not see that it is impossible for them to make this vegetable material grow upon the back of a tortoise.

"In 1873 Mr. Sandilands kindly gave me

one of these hairy terrapins, and upon that occasion a correspondent, 'A. B.,' kindly sent me the following note: 'In the "Travels of a Pioneer of Commerce in Pigtail and Petticoats," by T. T. Cooper (London, Murray, 1871, page 459), there is a plate of one of these hairy tortoises from the lakes of Ha-su, above Hankow. These curious little animals were about two inches long, and covered on the back with a long confervoid growth resembling hair. The tortoise being a sacred emblem in China, the Chinese make pets of the hairy tortoise, which they keep in basins of water during the summer months, and bury in sand during the winter. A small lake in the province of Kiang-su is

THE HAIRY WATER-TORTOISE.

famous for these so-called hairy tortoises, and many persons earn a livelihood by the sale of these curious little pets. The figure in Mr. Cooper's book looks like an oval door-mat with a tortoise-head sticking out at one end.'

"I have been to the British Museum to see if I could find anything like this hairy terrapin, but could not do so. I shall take the liberty of forwarding this article to his Excellency the Chinese embassador, who, I have no doubt, with his usual kindness, will obtain some further information about this great curiosity."

Spider-Architecture.—The snare of the basilica spider would form an interesting object of study for the architect. In it he will find many a difficult problem of constructive science happily solved, and it may be derive useful hints to guide him in the construction of more substantial edifices. As described in the "Proceedings of the Academy of Natural Sciences," of Philadelphia, by Rev. H. C. McCook, who has studied *Epeïra basilica* among the hills of the Colorado River, Texas, the snare of this spider is of composite structure, consisting of a pyramid of web, within which, near its base, is suspended a dome of the same material, and hanging beneath the open bottom of the dome is an horizontal sheet of cobweb. The structure is illustrated in Mr. McCook's paper, and the general effect will be understood if the reader will imagine a pyramidal tent of netting, inclosing a spread umbrella, with a screen of web suspended by cords from the inside of the umbrella and the tips of the ribs. The whole structure is usually suspended from a bush, and thoroughly steadied and its form perfectly preserved by means of silken guys. The meshes of the pyramid are irregular and very open; the sheet under the dome is also of irregular structure, but the dome is constructed of a vast number of radii crossed at regular intervals by concentrics, after the manner of the snare of the common orb-weaving garden-spider. At the bottom of the dome the radii are about one-sixteenth of an inch apart, and the concentrics extend entirely and with equal regularity to the summit, the meshes much resembling those of a fisher's net. The diam-

eter of the dome is from seven to eight inches at the base, and its height is about the same. The inhabitant of this most curious structure is thus described by our author: "The fore-part of the body, cephalothorax, is of a golden-yellow color, bordered and marked with blackish bands. The legs are of a delicate green, having the thighs marked by blackish longitudinal bands, and blackish annuli at the joints. On the back of the abdomen the colors within the blackish marginal lines are as follows: at the base, next the cephalothorax, a snowy white; the middle lobes are a light yellow, the lower lobes and the cruciform figure are a golden yellow. The bands and markings on the side of the abdomen are in the following order from the top, viz., crimson, white, dark green with light-green edges, blackish to dark green, yellow." But in the mind of the araneologist the special interest of the basilica spider is not its architectural skill, not its beautiful markings, but the fact that it seems to form a link between the orb-weaving and the line-weaving spiders.

Manufacture of Sea-Salt in San Francisco.—At Rock Island, in the bay of San Francisco, works have lately been established for reducing salt from sea-water by solar evaporation. The process of evaporating the salt-water is described as follows in the *Engineering and Mining Journal:* "The water is let into a large reservoir at high tide, and thence passed into a series of other reservoirs, until it has traversed a distance of fifteen to twenty miles, in the mean time steadily increasing in strength and dropping its limy impurities. In the fourth reservoir the specific gravity is 16°, and it leaves the seventh when it is 25°. Pure chloride of sodium begins to form when the brine attains this density, and continues to do so until it has attained 29°. During the strengthening of the sea-water from its natural specific gravity of about 1.03 to 25, the sulphate of lime held in solution crystallizes and settles to the bottom. It is not until a specific gravity of 29 is reached that chloride and sulphate of magnesia, bromide of soda, and chloride of potassium, begin to concrete. These being the principal if not the only impurities, with the exception of a little water, the manner of securing pure salt appears very simple. When at 25°, the pickle is run into crystallizing ponds or vats, some of which are simply the earth hollowed for the purpose; others are boarded on the bottom, while a third is made wholly of boards. In these the brine is allowed to remain until it is 28½°, when the salt which has formed in the bottom is shoveled into baskets, loaded on cars, and conveyed to another part of the island nearer the wharf, where it is piled up in great pyramidal-shaped mounds. These remain exposed to the sun and weather for a year, which whitens and purifies the crystals preparatory to grinding."

Atmospheric Electricity and Plant-Growth.—Atmospheric electricity is, according to M. Grandeau, a powerful agent in the process of assimilation in plants. Plants protected from its influence build up fifty to sixty per cent. less of nitrogenous matter than those subject to ordinary conditions; the proportion of ash is higher and of water lower. In the author's experiments different species of growing plants were inclosed within an electric screen consisting of four triangles of iron. The plants experimented upon were maize, tobacco, and wheat—two specimens of each—of which the one was screened from atmospheric electricity, the other not. The results of these experiments agree fully with the discovery made some time ago by Berthelot, that free nitrogen unites with organic matter under the action of electric currents not only from ordinary induction-coils, but even from feeble voltaic batteries. The proportion of nitrogen thus fixed in seven months in paper and dextrine was 1.92 thousandths.

Pure Teas.—The Chinese minister at Washington, Chin-Lan Pin, was lately visited by a delegation representing a firm of tea-importers in Baltimore, who wished to learn his views regarding the importation into this country of pure teas. The minister in his reply said that the various brands of tea sold in America and Europe are unknown to and not used by the tea-consumer in China. They are specially prepared by the Chinese tea-exporters for the foreign market. They are colored by the use of

chemicals; and the process, together with the peculiar methods of fixing up tea for foreign markets, not only renders the plant less palatable and beneficial, but more expensive. The adulteration and coloring of teas for the foreign market, he said, are wholly in consequence of the demand which has existed for such teas; and the minister expressed the opinion that if the Boards of Trade in New York and China would make known the fact that pure teas are not only better but cheaper, it would benefit both producer and consumer. There is, he said, really only one kind of tea-plant, and from this both the green and black teas are produced. The equivalents for the two terms "green" and "black" do not signify to the Chinese the color of the tea, as in America, but have reference to the period of gathering, "green" indicating to them, as in "green corn," not a color, but a state of immaturity.

Prof. Winchell on College Education.—Prof. Alexander Winchell, in a recent address, said that the ratio of college graduates to our population is continually diminishing; this, he held, would not be the case if college education were, under the conditions of modern life, as good a preparation for a successful career as it was in former times. But while the requirements of our time are totally different from those of earlier periods in the history of man, our system of education is still, to all intents and purposes, what it was in mediæval times. Among the deficiencies of our collegiate education, the most serious, according to Prof. Winchell, is ignorance of our national organization, laws, and political history, and of the principles and laws of political life; then, insufficient knowledge of the governments and history of modern European states and of their statesmen. Last, but not least, comes comparative ignorance of the natural sciences and of mechanical and free-hand drawing. Our so-called liberal education embraces but a pitiful amount of the systems of knowledge which are moving the world. Nor are these shortcomings confined only to our colleges and universities. In our elementary schools, at the age when every active power is ready to spring forth and seize the living truth, we try to satisfy with syntax, and a list of names from Siberia. "All children like to see pictures, and to make pictures; but, instead of fostering this useful instinct, a picture on the slate is as horrifying to Miss Nancy or Mr. Petrifact as the name of science is to our mediævalized theologian. When a boy is aching to take a locomotive to pieces, we set him to dissecting a verb. Let him gratify his curiosity; let him entertain himself with chemical reagents; give him means to make a telephone or a steam-engine; allow him to drive nails and a jack-plane; give him a microscope and a geological hammer. With these things he will unite hand-work with head-work in a most fruitful alliance; and when he becomes a man, he may be either a mechanically expert scholar or a scholarly mechanic. As a scholar he will understand affairs and possess the common-sense which will turn every situation to account. As a mechanic he will understand his business, and make a 'boss' who may be trusted without misgiving."

History of an Ant-Community.—Like Sir John Lubbock, the eminent French chemist Berthelot devotes much of his leisure time to studying the ways of ants. He has for years closely observed an ant-hill, which at first presented the form of a little conical hillock, peopled by thousands of inhabitants. The history of this community, as recorded by Berthelot, has a striking resemblance to human history—the same arts of peace and of war, the same distinctions of classes, the same fluctuations of fortune. The ants excel as hunters, as marauders; they have among them skilled architects, thrifty housewives. Division of labor is enforced. There are civilized ants and barbarians. The warriors despise the toil and drudgery of civil life, and they delight in making set raids, taking numbers of prisoners, and reducing them to servitude. While their betters are taking their walks abroad, or carrying on their wars, the slaves care for the young, and attend to the household affairs and economies. It is interesting to observe them while engaged in building. There are superintendents of work, and there are simple workers. Sometimes the latter make mistakes; for instance, suppose they have to build an arch,

they make an error in determining the proper curve. But when the superintendent comes he notices the mistake, pulls down the faulty piece of masonry, and corrects the error.

When M. Berthelot first saw this ant-city it had already been in existence for some years, and was in the high tide of prosperity. Ten years later it sent out a colony, which settled at the foot of a young oak, distant a few metres from the mother-city. This colony, at first weak and occupying but little ground, increased year by year. The war of 1870 for a while interrupted the course of M. Berthelot's researches, but on the return of peace there was a new surprise. The mother-city was now in a state of decline, but the colony was thriving wonderfully. In the old home there were but few births and few fruitful unions; the number of inhabitants had grown less, and the survivors were careless of their dwellings. The colony has now become the principal city, it has sent out a sub-colony which is in a flourishing condition. The old city is compared by M. Berthelot to Babylon, with its thriving neighbor cities of Seleucia and Ctesiphon.

Persian Hair-Dye.—The practice of dyeing the hair is very much in use among the Persians, who mostly employ the plant henna for this purpose. According to Dr. Tholozan, the private physician of the shah, the powdered leaves of the plant are made into a paste with hot water and then applied to the head, the hair, and the nails. This is done in a vapor-bath. This first application lasts an hour and a half to two hours, and then the parts are freely washed in water. The henna gives an orange-red color, very beautiful on a white beard, so that many old men use it. To change the reddish color of hair into a fine, lustrous black, the parts are coated, at the same sitting, with a paste formed of another powder—that from the leaves of a kind of indigo-tree cultivated in Persia. This is called *reng;* it remains applied about two hours. The henna gives different colors according as it acts on white, fair, or dark hair. It alters very quickly in moisture, and loses its properties in long sea-voyages. Experience seems to have proved that it gives suppleness to hair, but it causes it to whiten prematurely. Fair-haired people in Persia always color their hair black, but the black is not so intense as that produced in persons of dark complexion. Skin reddened and blackened with the two pastes soon regains its natural color on being washed with soap and rubbed with the fingers, whereas the dye adheres firmly to the hair, which it penetrates. Reng is sometimes used alone, and gives a blue-violet color.

About Oleomargarine.—Mr. John Michels points out, in the *American Journal of Microscopy*, the differences between butter and oleomargarine as observed with the microscope. Two woodcuts illustrate the paper, the one exhibiting the microscopic appearance of oleomargarine, the other that of butter. In the former substance are seen numerous stellate or feathery crystals, together with globules. In butter none of the crystals are seen, the whole field of the microscope being filled by the globules, with perhaps crystals of common salt. Besides these stellate crystals, Mr. Michels found in all the specimens of oleomargarine examined by him fragments of tissue and muscle, also certain *cells of a very suspicious character*. What these cells may be the author does not assume to decide, but he appears to suppose that they might possibly be the larval forms or eggs of *entozoa*. Some of Mr. Michels's observations on oleomargarine and its suitableness for human food having been called in question, in particular his statement that living *septic organisms* may exist in the artificial butter, he submitted the matter to the Rev. W. H. Dallinger, of Liverpool, a very high authority indeed. Mr. Dallinger's reply is given in full by the author. He writes: "A temperature of 120° [which is the highest temperature employed in the manufacture of oleomargarine] is not by any means seriously, and certainly not permanently, injurious to even the *adult* forms of the putrefactive organisms." Again: "Quite as serious a matter is that of the introduction, through oleomargarine, into the human intestinal tract of eggs of *entozoa*. I have made enough experiments to say that the eggs, for example, of the *nematoda* are practically uninjured by 120° Fahr. This," Mr. Dal-

linger adds, and his warning will carry great weight, "is an important matter, and, although likely to be in practice neglected at first by the public, may *probably impress itself upon them in an unwelcome manner*" —that is, by a serious outbreak of trichinosis, or some other form of parasitic disease.

Cultivating Disease.—The virulence of the yellow fever in Memphis is easy to account for when the sanitary conditions of that city are understood. Two or three years ago we published some mortality statistics concerning this place, which appeared to show that it is exceptionally unhealthy. It would indeed be nothing short of a miracle if Memphis were a healthy city with its highly insanitary surroundings. The situation is thus described in the *Lancet and Clinic*, by Dr. S. H. Collins, a Cincinnati physician, who rendered efficient service in Memphis as a volunteer during the prevalence of the epidemic: "Memphis is situated upon the east bank of the Mississippi, upon a bluff varying from fifteen to fifty feet in height. Upon the crest of this bluff runs Front Street; from this street the ground slopes eastwardly away from the river, so that all rain, surface-gutter washings, slop, and whatever of floatable filth there may be, is drained into the bayou, which winds about through the heart of the city. Across the river the Arkansas shore stretches low and flat, a vast marsh, notorious for its malaria; north and east of Memphis upon the Tennessee side, the land is low and swampy; the soil in and about the city, of clay. The bayou runs through the most thickly-populated parts of Memphis; into this elongated cesspool is collected all the floating filth of a city of 55,000 inhabitants; garbage, the drainings from privy-vaults, gutter and street washings, dead animal matter, all and everything is poured or thrown into this receptacle, there to decay and fester under the broiling sun of that southern climate. Consider it, if possible—ten miles of reeking rottenness! Not a yard of it covered except where crossed by the bridges of the various streets. During a rise of the Mississippi the back-water fills this bayou bank-full, its accumulated filth then soaking into the clay of its banks. When the river falls, the current of the bayou is not of sufficient strength to empty its contents into the river. The streets of the city of Memphis are beyond description filthy, and completely out of repair; the wooden pavement is the one in use, or rather was the pavement originally put down. The streets and yards are heavily shaded—the magnolia being the tree mostly used."

The Movements of Plants.—After much patient study of the phenomena known as heliotropism and the sleeping and awaking of plants, M. Paul Bert, in a memoir addressed to the Paris Academy of Sciences, an abstract of which is published in the *Revue Scientifique*, offers an ingenious theory to account for them. The swelling of the flower or leaf stem just below these organs has long been recognized as the seat of the movements in question, and hence it has been called the "motor-swelling" (*renflement moteur*). The movements are directly produced by changes in the energy with which the *renflement moteur* supports the flower or leaf, and this energy is greatest at night. For a long time the author was baffled in his investigation of the matter constituting the "motor-swelling." Nevertheless, after a protracted series of minute observations, he recognized in the glucose the fundamental cause of the periodic movements. It is known that this substance is formed under the action of solar light, that it is decomposed in darkness, or that it migrates and sometimes accumulates at different points of the plant organism. Now, one of these points is the *renflement moteur*, and it is very plain that its quantity there varies at the different stages of the diurnal life of the plant. Thus the greater part of the phenomenon is due to the storing up and then to the destruction of the glucose, the hydration of which produces the energy of the motor-spring. The same explanation serves to account for heliotropism, another phenomenon due to the action of the highly-refracting rays of the spectrum on glucose or on its hydration. Inasmuch as the action of these rays lessens the tension on that side of the "motor-swelling" on which they fall, the opposite side gains a relative increase of energy, and hence results a certain motion; and, as the sun moves on

its course, the leaf follows, but the reason is always a diminished tension on the illuminated side. This is true of the stalk as well as of the flower. Hence the two phenomena of periodic movement and of heliotropism depend on variations in the quantity of the glucose contained in the point of movement.

Value of the Robin to the Agriculturist.—Like the English sparrow, the "robin" (*Turdus migratorius*) has human enemies and detractors who will not admit that he is of any use whatever to the gardener and fruit-grower; but assert that he prefers to grow fat on stolen cherries and other small fruits, rather than on an insect-diet. But what are the facts? Lieut. D. A. Lyle, U. S. A., reared a robin from the fledgling state to maturity, in the mean time closely studying the bird's preferences in the matter of food, and here is the result of his observations, as communicated to the *American Naturalist:* On being taken from the nest, the young bird was placed in a cage, with plenty of boiled eggs and mashed potatoes and pure water. He would neither eat nor drink, but sat drawn up in the bottom of the cage, giving vent to an occasional chirp. The food was then forced down his throat, and this treatment revived the patient somewhat, but did not give entire satisfaction. He then received raw beefsteak three times a day, with bread and egg at intervals. The effect was striking: the eyes brightened, the chirp became loud and strong, and the bird would hop about briskly. He soon learned to open his mouth for the food. Next he was for three days restricted to a diet of earthworms, of which he would eat his fill, and then retire moodily to a corner, there to remain for about fifteen minutes, till the meal was digested. But, as this food acted as a purgative, it was alternated with beefsteak. The June beetle being then in season, that species of food was tried, and the bird preferred it to anything else. As long as June beetles could be procured, they constituted the sole food of the bird, and he thrived marvelously on it. Every day he consumed forty to fifty of these large beetles. "One morning," writes Lieut. Lyle, "at seven o'clock I gave him fifteen; I returned from the office at twelve, and from that time until sunset I fed him all he could eat. During this time he disposed of seventy-two of the large beetles!" When the June bugs were no longer to be had, cherries were given to the bird. These, when he was hungry, he would eat greedily, but they were speedily rejected when a few coleoptera or a piece of raw steak appeared in sight. The author then makes an estimate of the number of insects probably destroyed *per diem* by the twenty-three pairs of robins occupying the grounds around his residence, taking as the basis of his calculation the performance of his captive robin, and finds that the number would be at least 4,600, or 138,000 per month! Examination of the cherry-trees growing on the grounds showed that only about one cherry in twenty had been injured by the birds—a very low price to pay for their service in exterminating the noxious insects.

Gelatine as a Food-Preservative.—Dr. Campbell Morfit's "gelatine process" for preserving articles of food—as milk, vegetables, fruits, etc.—possesses many advantages which will undoubtedly win for it a very general acceptance. It consists in adding to the substances to be preserved a certain proportion of gelatine, and then drying the mixture till it does not contain over 10 or 12 per cent. of moisture. The mode of applying the process to the preservation of milk is described as follows in *Nature:* One pound of gelatine is dissolved in a gallon of milk at a temperature of 130° to 140° Fahr., and the solution is then allowed to set into a jelly, which is cut into slices and dried. By employing the product of this first operation in place of fresh gelatine for gelatinizing a second gallon of milk, a jelly is obtained in which the milk solids are just doubled in amount. As a gallon of milk contains about 6,400 grains of these solid matters, viz., casein, milk-sugar, milk-fat, and phosphates, their ratio to the gelatine will become as 12,800 to 7,000 after the second operation just described. If, then, the dried *milk jujube*, as it may be now called, be again and again employed with successive quantities of milk, a limit is reached when the one pound of gelatine has been incorporated with ten gallons. At this stage the mixture will contain no more than one part of gelatine

to ten of the nutritive matters of milk—a proportion of added preservative material which contrasts very favorably with the 25 to 28 per cent. of sugar found in ordinary condensed milk. If the one pound of gelatine required could be at once dissolved in the whole eight or ten gallons of milk, the process would be simplified and cheapened; but gelatinization could not then be secured, for it is the gradual drying up of the slabs of jelly, with which the animal and vegetable food materials have been uniformly incorporated, that envelops every particle of changeable substance with an adequate protective coating of gelatine.

Notes on Afghanistan.—Afghanistan is happily described by a writer in the *Geographical Magazine* as a star of valleys radiating from the stupendous peaks of the Koh-i-Baba, and bounded all round by very rugged and difficult mountains. These valleys are traversed by streams which flow in various directions, the most important of them being the Cabool and its tributary the Kunar, the Argandab, the Helmund, the Harirud, and the Murghab. The appalling grandeur of some of the defiles north of the Hindoo-Koosh—a name applied to the whole line of Alpine water-shed stretching southwest from the southern end of Pamir—is not surpassed anywhere, while many of the sheltered glens on the southern slopes of that range are the delight of travelers. The general elevation of the country, which is considerable, diminishes toward the frontiers, and as its face becomes lower the rivers are absorbed by irrigation or lost by evaporation, and a belt of very barren, desert-like land is thus formed, bounding Afghanistan on all sides except the northeast corner. The spurs of the Hindoo-Koosh run out on both sides into the basins of the Oxus and the Cabool. Its peaks in all probability rise throughout to the region of perpetual snow, and the loftiest attain 20,000 feet in height, or over. This mighty range is pierced by upward of twenty passes, all leading from the basin of the Oxus to that of the Cabool. The climate is very diversified, but this is due to difference of elevation rather than of latitude. At Ghazin (7,730 feet) the winters are very severe, and here, as well as in the Hazarajat, the people stay in their houses during the cold season. The summer heat is everywhere very great, except in the most elevated parts of the Hindoo-Koosh and other lofty mountains. A deadly hot wind blows over the southwestern portion of the country, which is a sandy and almost uninhabited desert. For nine months the sun shines with the greatest possible splendor in Afghanistan, and the nights are even more beautiful than the days. The geology of the country is but little known. Antimony, iron, and lead, are found in the Ghorband Valley, and quarries of white marble in the hills near Maidan. Copper is found in various localities, but the deposits are unworked. Lead is obtained from the Hazara country; sulphur from Pir-Kisri, on the eastern confines of Seistan; and zinc and nitre from the Zhob Valley and Herat respectively. The main wealth of Afghanistan consists in the domestic animals—the horse, camel, cow, etc. The population is estimated at a little below 5,000,000. Wheat is the staple food; rice is largely grown; other agricultural products are turnips, ginger, turmeric, sugar-cane, castor-oil plant, madder, asafœtida, tobacco, and fruits.

Japanese Fermented Liquors.—Some time ago Prof. De Bary, of Strasburg, discovered that alcoholic fermentation can be effected by the growth of a species of *Mucor*. Singularly enough, as we learn from a communication in *Nature*, by Prof. R. W. Atkinson, of the University of Tokio, this agency for bringing about alcoholic fermentation has long been known in Japan breweries, where it is employed in preparing from rice the alcoholic liquid called *saké*. In the breweries at Hachiôji the main room is usually one hundred and twenty by fifty feet, and twenty-five or thirty feet high; along the middle of it is a platform about twelve feet from the ground; on this are ranged wooden tubs, which serve for the preparation of the ferment, an operation repeated several times during the brewing-season. At the close of the previous season a quanty of green mould is produced on rice by exposing steamed rice mixed with ashes, and over which the spores of this fungus have been scattered in a well-closed chamber—the "fungus-chamber"—a small room

about seven feet high, six feet broad, and eight feet long, well lined and covered with straw and matting, so that its high temperature may be kept up for a considerable time. In this chamber the rice and spores are left about ten days, and then they are found to be covered with a green fungus full of spores. This product is called in Japanese *tané*, or seed. When it is required to commence operations a similar method is adopted—that is, a quantity of steamed rice is placed on wooden trays in the "fungus-chamber," but not mixed with wood-ashes, and then *tané* is scattered over it, and the chamber kept closed for from two to four days. The rice-grains are then found to be covered with large quantities of fine, hair-like threads—the *mycelium* of the fungus. In this state it is called *koji*. To prepare his yeast, the brewer mixes steamed rice with thirty per cent. of its weight of *koji* and sufficient water to make a thick mud, in shallow tubs, which are kept on the central platform. It is frequently stirred with wooden tools for about ten days, and thus the grains of rice are broken down, the whole assuming a much thinner consistence, and the liquor becoming decidedly sweet. This is a change for which the author cannot yet fully account. After the end of the ten days this product is mixed with freshly-steamed rice, water, and *koji*, and placed in larger wooden vessels, in which the mixture is heated by means of closed wooden tubs containing hot water; and the temperature is maintained for from eight to thirteen days at about 95° Fahr. Meanwhile there is continuous development of gas, and a scum gradually forms on the surface till it is about an inch thick, and under the microscope presents the usual appearance of brewers' ferment—*saccharomyces*. The product of this operation is called *moto*—source, or origin—the yeast. The actual fermentation has three stages, called "beginning," "middle," and "end," the proportions of steamed rice varying slightly in each, but giving a final result of one hundred parts of steamed rice to thirty of ferment. This mixture, with the proper quantity of water, is placed in large tuns, and allowed to remain fifteen days, during which there is active fermentation, and the liquid becomes strongly alcoholic, at the end of which time it is drawn off from the grains of rice which have subsided, and put in other tuns, where it stands till the remainder of the rice is separated. The liquor is now heated to 140° Fahr., after which it is kept in store vats, carefully sealed up. This *saké* contains about fifteen per cent. alcohol.

A French Agricultural School.—It is a true remark that in France sundry matters of practical administration are better understood than elsewhere, and it may be that an account of a French agricultural school will suggest a few useful ideas to those who conduct similar institutions in this country. At Grignon, near Versailles, is an institution of this kind, concerning which the *Revue Scientifique* gives the following notes: There are three classes of students, viz., *internes*, or boarders, who constitute the majority; *externes*, who live outside of the institution, but who are required to attend all the exercises of the school; and *auditeurs libres*, who are free to select among the different courses of instruction such as they prefer. Students of the first class pay 1,200 francs per annum for board, lodging, and tuition, and those of the other two pay 200 francs. The course of study extends over a period of two and a half years, and pupils are admitted in October after passing an examination. In March, at the close of the first semester, they are examined on the subjects they have studied during this first term, and those who do not pass this ordeal successfully are dismissed. Similar eliminatory examinations take place at the end of each semester. The final examination is in March, thirty months after admission, the most meritorious students receiving diplomas, and the others a certificate of study. The number of branches taught is considerable, viz.: Chemistry, both general and agricultural; rural economy; agriculture; rural engineering; botany; technology; silviculture; zoötechny; meteorology, and geology. In addition, instruction is given in book-keeping and in hygiene, and there are lectures on special subjects. The instruction given in each branch of study is fortified by practical applications under the direction of the professors and

their assistants, and the students are familiarized with chemical manipulation, the determination of the different kinds of minerals and plants, draughting, land-surveying, the management of animals, agricultural machines, etc. The farm attached to the school comprises 300 hectares (about 750 acres).

Noxious Vapors and Health.—In the report of an English commission on noxious vapors given off in the course of various manufactures, a principle is laid down which, if accepted by courts, would afford a speedy remedy for many of the ills of modern life. What the report says with special reference to alkali and copper works may be applied to such nuisances as fat-rendering and petroleum-refining establishments; also to such destroyers of quiet as elevated railroads. "To be free from bodily discomfort," says the report, quoting the words of Mr. Simon, "is a condition of health. If a man gets up with a headache, *pro tanto* he is not in good health; if a man gets up unable to eat his breakfast, *pro tanto* he is not in good health. When a man is living in an atmosphere which keeps him constantly below par, as many of those trade-nuisances do, all that is an injury to health." But it is more than doubtful whether the commission will be able to enforce any measures that will effectually abate these nuisances. It is admitted that, besides the direct injury to the public health, noxious factory-gases are chargeable with doing serious damage to agriculture. Cattle die from grazing on poisoned herbage, farms become parched up, yellow, and cannot be tenanted; parks, woodlands, and hedges, are slowly annihilated. But the factories give employment to the population, and working-people are content to labor even in an unwholesome atmosphere for their daily bread. To require the entire suppression of nuisances involves outlay of money, and, in the present depressed state of manufacturing industry in Britain, proprietors are unwilling to incur expense. They would close their establishments, so throwing people out of employment, rather than burden themselves with the cost of carrying out the provisions of such a law as the sanitarians demand. Said the President of the Salt Chamber of Commerce: "We are taking no steps whatever to consume our own black smoke. The local authority must fine me as long as they can; if they fine me to too great an extent I shall have to shut up. This will be the case with all of us, and the trade will be driven from the district."

A Defense of the Sparrows.—Dr. Elliott Coues's "railing accusations" against the English sparrow have called forth many a hot-tempered reply from the friends of that bird, some of whom are so unpatriotic as to prefer the foreign intruder to the feathered songsters of their native land. Among these partisans of the English sparrow must be numbered Mr. Robert B. Roosevelt, who, in a late number of *Forest and Stream*, scruples not to answer "railing with railing." Dr. Coues, it will be remembered, makes five distinct categories of the sparrow's friends; Mr. Roosevelt does not care to differentiate the bird's enemies, but lumps them in one class, the "sparrow-hawks." The sparrows are worthless idlers, say these sparrow-hawks; but what, asks Mr. Roosevelt, was the condition of our city parks and tree-shaded streets before the advent of the sparrows? Were they not practically impassable from the numbers of disgusting measuring-worms which hung in festoons from the limbs of the trees? The parks were abandoned absolutely to the worms, which by June had stripped every leaf, often killing the trees, and making them as bare and denuded as in mid-winter. The sparrows came, and everything was changed. "But," say the sparrow-hawks, "our native birds might have done the same service." "Might have done!" exclaims Mr. Roosevelt, contemptuously; "they never did." On the other hand, the sparrows "did not pave the parks with good intentions, but set about their appointed work and did it. They did not idle on bush or limb to squeak a feeble attempt at harmony" (such is the fling the author makes at our native feathered songsters); "they did not slip off to steal fruit; they did not satisfy their minds and feel that they had performed the whole duty of birds by setting up their feathers and saying, 'How pretty I am!' They were expected to kill worms, and they killed them. Early and late, without folly or idleness or

wicked indulgences, they performed their duty till the measuring-worms ceased to be, and the place that knew them knows them no more. Go on, good sparrow!" But we have not the space to give the eloquent apostrophe in which the author encourages the sparrow to go on with his good work.

Death of Mr. Thomas Belt.—With deep regret we have to announce the death of Thomas Belt, geologist and naturalist. He died, September 22d, at Denver, Colorado, of rheumatic fever. The following biographical notice is from the London *Athenæum*: "The son of the late Mr. George Belt, nurseryman and seedsman of Newcastle-upon-Tyne, Thomas Belt was a practical botanist almost from his infancy, and his scientific tastes were further developed in the two schools which he attended—the earliest presided over by Dr. J. C. Bruce, of antiquarian fame, and the second by the late John Storey, a man second to none of his day as a north-country botanist. In the latter establishment young Belt had as schoolfellows two boys who have since stamped their names in the annals of science—Prof. G. S. Brady and H. B. Brady, F. R. S. In 1851 Thomas Belt joined in the first great gold rush to Australia, and since that time his life has been that of a hard-working, successful mining engineer. He visited all parts of the world in the course of his profession, but whether as a digger in Victoria, as a manager of mines in Central America, or as a prospector in the wilder parts of Russia, the engineer was always a naturalist at heart. He was an excellent observer, and a certain speculative tendency led him to group his observations so as to bring out their full theoretical bearings. He was minutely accurate in his description of facts, and bold in his generalizations. He covered so much ground that some of his theories may not bear the test of further research, but some will stand, and all bear witness to the singular grasp of his mind. The chief results of his work are to be found in his papers read before the Geological Society (of which he became a Fellow in 1866), and in a most interesting book entitled 'The Naturalist in Nicaragua,' and published in 1874. In biology Mr. Belt was an advanced evolutionist, and in geology an ultra-glacialist. In both branches of science his papers were suggestive in the highest degree. What he did was so good that much was expected of him, and his sudden loss is an irreparable one to the rapidly-thinning group of eminent Tyneside naturalists to which, by right of birth, he belonged."

NOTES.

THE American Public Health Association will hold its sixth annual meeting at Richmond, Virginia, beginning on the 19th and ending on the 22d of November. The first days of the session will be devoted to the report and evidence submitted by the Yellow Fever Commission recently named by the Surgeon-General of the Marine Hospital Service.

THE project of a railroad across Newfoundland is again being agitated. Such a railroad would have the effect of shortening by one thousand miles the ocean-voyage from this continent to Europe. It is stated in the *Polytechnic Review* that the Government of Newfoundland has agreed to vote an annual subsidy, and to make a grant of lands in aid of the enterprise. Among the incidental benefits to be derived from such a line of railway may be named the opening up of vast deposits of copper, iron, coal, nickel, lead, and other minerals. Furthermore, it would cut through the great pine and spruce forests of the interior of Newfoundland.

SIR GEORGE NARES, who commanded the expedition of the Alert and Discovery to the polar regions, is about to make another scientific voyage to the South Pacific. He will first make soundings in the track of navigation between New Zealand and Feejee, and will then ascertain the positions of the different reefs and islets off the northwestern coast of Australia.

DR. J. S. MEYER, of Virginia City, Nevada, claims that he has discovered the "lost art," known to the ancient Egyptians, of tempering copper so as to produce an edge which will cut like steel.

THE Government in India is introducing agricultural schools. The native methods are wretchedly poor, and little wonder is it that the famines are occasionally dreadful. "The curse of Indian agriculture" is said to be the inveterate custom in many places of using the cattle-manure for fuel. To stop this a law is recommended for the compulsory planting of fuel trees, which also would have a good climatic effect.

A GERMAN resident on the island of Java has succeeded in domesticating the native honey-bee (*Apis dorsata*). The hope is indulged that this Javanese bee may be acclimated in Europe, and, if so, in America. The only value hitherto set upon the insect by the natives has been for its larvæ, which they used for food.

THE distinguished geologist and engineer, Sir Richard John Griffith, Bart., died in Dublin, September 22d, aged ninety-four years. In 1854 was completed his "Geological Map of Ireland," for which he received the Wollaston Medal of the London Geological Society. From an early age till 1864 he was connected with the Irish Board of Public Works, and was chairman of the board for the last twelve years of that period.

THE editor of the *American Builder*, in looking over the statistics of education in the United States, observes some facts which strike him as curious, for instance, that while there are 579 colleges, universities, law, medical, and theological schools, there are only 83 schools for the higher mechanical and scientific education, including all schools of design, mining, and engineering. Again, the theological schools are twice as numerous as the engineering, scientific, and mechanical schools. "No wonder," he remarks, "that many trained preachers in this country go hungry to bed, while thousands of enterprising mechanics and artisans are floundering in a sea of ignorance in search of higher scientific attainments."

PROF. FISCHER, who was lately found dead in the laboratory of the Prague Gymnasium, was the victim of a theory. Having mixed sal-ammoniac with cyanide of potassium, he bade his attendant to note how "science has advanced so far as even to be able to render harmless so dangerous an agent as cyanide of potassium." With that he tasted the mixture, and was quickly seized with violent pains, and expired before a physician could arrive.

A STRIKING illustration of the value of the electric light at sea was given during the homeward voyage of the telegraph-steamer Faraday from New York to London last August. About 10.30 P. M., July 18th, in the vicinity of George's Bank, in a dense fog, with a fresh westerly wind, suddenly was heard the sound of a bell ringing furiously but a short distance ahead. The steamer's engines were immediately stopped, and the captain, supposing it to be a fisherman at anchor or almost stationary, ordered the wheel to be ported; at the same moment the electric light of the Faraday pierced the fog, and plainly showed a ship crossing her bows. Not a moment was to be lost, and only by the coolness and presence of mind of the captain was a fearful calamity averted. The two vessels were within a few feet of each other; the look-out men said they could have stepped on the stranger's stern. She was full of passengers, and the cries of women and children were heartrending. "Had I not been able," writes the captain, "to see her so plainly, and the way she was going, we must have gone over her, or she might have struck us on the port bow; in either case the loss of life must have been great, and even now it seems terrible to contemplate."

COLOR-BLINDNESS is, according to M. Favre, consulting physician of one of the great railways of France, a frequent result of the abuse of alcohol and tobacco. He would interdict to every railway-man holding a responsible position the use of tobacco or alcohol in any form, because they tend to impair not only the power of discriminating colors, but also that of estimating distances and of perceiving objects.

THE piano war having ended, at least in the newspapers, the war of the mineral waters appears to have succeeded to its place. There are two kinds of mineral waters, the natural and the artificial. The natural waters alone possess all the medicinal virtues of the sources after which they are named—as Apollinaris, Seltzers, Vichy, etc.—at least so we are assured by the "naturalist" faction. The other side, the "artificialists," claim that their product is best and purest; besides, they boldly assert that their adversaries are no better "naturalists" than themselves; that, in fact, the so-called "natural" mineral waters are freely doctored, and hence artificial. One of the "artificialists" is out in a circular, in which he quotes from the very chemists of the opposite side, to show that the Apollinaris water imported into this country differs very much from the water as it comes from the Apollinaris spring. The natural water contains of chloride of sodium 4.66 parts in 10,000, but the bottled article contains 14.088 parts. Further, the iron of the original water is removed, and the water is charged artificially with carbonic-acid gas. Hence, it is claimed, this product is strictly "artificial."

THE governor of the Chinese province of Chihli has employed Mr. Arnold Hague, of San Francisco, an expert mining engineer, to examine and report on the mineral resources of Northern China.

ON the occasion of the inauguration of the monument to Giordano Bruno, the Italian Government will publish the complete works of that great and original philosopher.

GUSTAV WALLIS.